A CLINICAL STUDY ON DIABETIC RETINOPATHY AND ITS MANAGEMENT

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COIMBATORE

CERTIFICATE

This is to certify that the Dissertation entitled ***"A CLINICAL STUDY ON DIABETIC RETINOPATHY AND ITS MANAGEMENT"*** *is a bonafide work of* ***Dr. E.ANITHAA,*** *Post Graduate in Ophthalmology, Coimbatore Medical College. The thesis work has been prepared by her under my guidance and supervision from January 2006 to October 2007 and this dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University in partial fulfillment of the regulation for the award of Degree of M.S in Ophthalmology.*

Dr.HEMALATHA GANAPATHY, M.D.
DEAN
COIMBATORE MEDICAL COLLEGE

PROF.DR.V.R. VIJAYA RAGHAVAN
MS, DO, DNB, FRCS (Ed).
PROF. AND HEAD
DEPARTMENT OF OPHTHALMOLOGY
COIMBATORE MEDICAL COLLEGE

DECLARATION

I solemnly declare that the Dissertation titled ***"A CLINICAL STUDY ON DIABETIC RETINOPATHY AND ITS MANAGEMENT",*** *was done by me at Coimbatore Medical College & Hospital during the period from January 2006 to October 2007 under the guidance and supervision of* ***Prof. Dr. V.R. VijayaRaghavan.***

This dissertation is submitted to the Tamilnadu Dr. M.G.R. Medical University towards the partial fulfillment of the regulation for the award of M.S Degree in Ophthalmology.

Place: Coimbatore ***Dr. E. Anithaa***
Date:

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Dr. E. Anithaa

TABLE OF CONTENTS

Introduction

INTRODUCTION

Diabetes mellitus is a syndrome characterized by chronic hyperglycemia and disturbances in carbohydrate, protein and fat metabolism associated with absolute or relative deficiencies in insulin secretion or it's action.

The metabolic dysregulation associated with diabetes mellitus causes secondary pathophysiological changes in multiple organ systems that impose a tremendous burden on the individual with diabetes.

It's deleterious effects on multiple organ systems like eye, renal system, heart and nervous system results in diabetic retinopathy, nephropathy and neuropathy by microangiopathy. Being a microangiopathy affecting precapillary arterioles, capillaries and venules, it presents itself either as non proliferative diabetic retinopathy, maculopathy or proliferative diabetic retinopathy. The fact that the onset of moderate and severe visual loss resulting from diabetic retinopathy can be delayed and often kept controlled by good glycemic control, timely intervention in arresting the progression of retinopathy, early treatment and regular follow-up has been extensively studied and documented.

Effective control of risk factors including hyperglycemia, elevated blood pressure and hyperlipidemia delays progression of microangiopathy.

Introduction of laser in ophthalmology is a breakthrough in the treatment of severe nonproliferative and proliferative diabetic retinopathy. Laser photocoagulation is the preferred treatment in cases of severe nonproliferative, proliferative diabetic retinopathy and clinically significant macular edema. Vitrectomy can be done for massive and recurrent vitreous haemorrhage and also for tractional retinal detachment.

Newer researches are being done on the usefulness of antivascular endothelial growth factor in the treatment of diabetic retinopathy. It's efficacy in arresting and reversing the disease process is under study.

R eview of Literature

HISTORY

1856	-	Von Jager	-	first described diabetic retinopathy
1890	-	Hirschberg	-	first classified & elaborated retinopathy
1943	-	Ballantyne Lowenstein	-	clinical and histological confirmation of diabetic retinopathy
1949	-	Ashton	-	
1949	-	Gerd Meyer Schwickerath	-	first recognised therapeutic effect of light on retina
1950	-	Jonas Friedenwald	-	histopathological characterisation of DR[J1]
1953	-	Aarseth	-	hereditary factors in diabetic retinopathy
1962	-	Patz, Moumenee	-	micro aneurysms in a diabetic dog
1965	-	Engerman, Bloodworth Molitor	-	retinal changes in dogs rendered diabetic
1966	-	Gay, Rosenbaum	-	asymmetrical retinopathy in carotid insufficiency
1976	-	Diabetic Retinopathy Study	-	preliminary report on effects of photocoagulation therapy
1984	-	Wisconsin Epidemiologic Study on Diabetic Retinopathy	-	prevalence of diabetic retinopathy
1985	-	Early Treatment Diabetic Retinopathy Study	-	effect of photocoagulation on diabetic macular edema
1985	-	Diabetic Retinopathy Vitrectomy Study	-	effect of early vitrectomy for severe vitreous haemorrhage
1988	-	United Kingdom Prospective Diabetic Retinopathy Study	-	effect of blood pressure and blood glucose on diabetic retinopathy
1993	-	Diabetes Control & Complications Trial	-	effect of intensive control of blood glucose on retinopathy
1998	-	Klein	-	risk factors and progression of DR
2002	-	Marbidis, Duker	-	intravitreal triamcinolone for refractory diabetic macular edema.

3EPIDEMIOLOGY

Diabetes is the most prevalent disease in middle aged and elderly. The Third National Health and Nutrition Examination Survey showed impaired fasting glucose and impaired glucose tolerance in 9.7% and 15. 6% respectively in the 40 – 74 years age group.

Wisconsin Epidemiologic Study on Diabetic Retinopathy (WESDR) provides information regarding the prevalence and risk factors associated with diabetic retinopathy. It studied the disease among type I and type II diabetes. In younger onset group, which consists of patients whose age at diagnosis of diabetes was < 30 years, retinopathy was seen in 13% of patients with < 5 year duration of diabetes and it is 90% in 10- 15 years duration of diabetes[S2]. PDR is present in 25% of patients with type I diabetes and 15 years duration.

In older onset group, which consists of patients whose age at diagnosis of diabetes was ≥ 30 years of age and < 5 years of diabetes, 40% of those who take insulin and 24 of patients not on insulin have retinopathy. PDR develops in 2% of patients with type II diabetes and < 5 years of diabetes and 25% in patients with ≥ 25 years of diabetes.

The prevalence of diabetic macular edema is approximately 18-20% in both Type I and Type II diabetes[S2].

RISK FACTORS

- Level of glycemia
- Elevated serum lipids
- Blood pressure
- Duration of diabetes mellitus
- Pregnancy
- Renal disease
- Coronary artery disease

Level of glycemia

Hyperglycemia is a strong factor in the development and progression of diabetic retinopathy. Benefits of better control continue to manifest even after nonproliferative and proliferative diabetic retinopathy has developed. Elevated glycosylated hemoglobin (HbA_{1c}) is a strong factor for the progression to high risk PDR[J2,3]. There is a 35% decrease in the risk of retinopathy progression for every 10% reduction in the presenting HbA_{1c} level[J4]. The higher the level of HbA_{1c} , the higher the risk of developing complications related to diabetes[J5].

Serum lipids

Elevated levels of serum cholesterol is associated with increased severity of hard exudates[J2,3,6]. Elevated serum triglyceride levels are associated with an increased risk of developing high risk PDR[S3,4] and decreased visual acuity.

Blood Pressure

Intensive control of blood pressure slows down the progression of retinopathy and reduces the risk of other microvascular and macrovascular complications of diabetes mellitus[S6J7]. Abnormal systolic and diastolic blood pressures are associated with the severity of retinopathy in both type I and type II disease. In type I, both are important and in type II, only systolic BP is related to the progression of the retinopathy[S3].

Duration of diabetes

Duration of diabetes is a significant risk factor for the development of diabetic retinopathy [S2,3,4]. After 20 years of diabetes, all the type I and ≥ 60% of type II patients have some degree of retinopathy.

When age at diagnosis is <30 years[J2] –

<5 years of diabetes - retinopathy uncommon

<10 years of diabetes	-	1.2% have PDR
>15 years of diabetes	-	95% have some degree of retinopathy.
>35 years of diabetes	-	67.2% have PDR

When age at diagnosis is ≥30[J3] years –

<5 years of diabetes	-	40% taking insulin have retinopathy 25% taking OHA have retinopathy 2% have PDR
>15 years of diabetes	-	84% taking insulin have retinopathy. 53% taking OHA have retinopathy
>25 years of diabetes	-	25% have PDR

Pregnancy

Retinopathy is accelerated during pregnancy because of pregnancy itself or the changes in the metabolic control[J8].

Renal disease and Coronary artery disease

Both are associated with increased incidence of proliferative retinopathy.

SEX INCIDENCE

Male sex is associated with more severe retinopathy. The male : female ratio is 3:2[J1,2].

GENETIC FACTORS

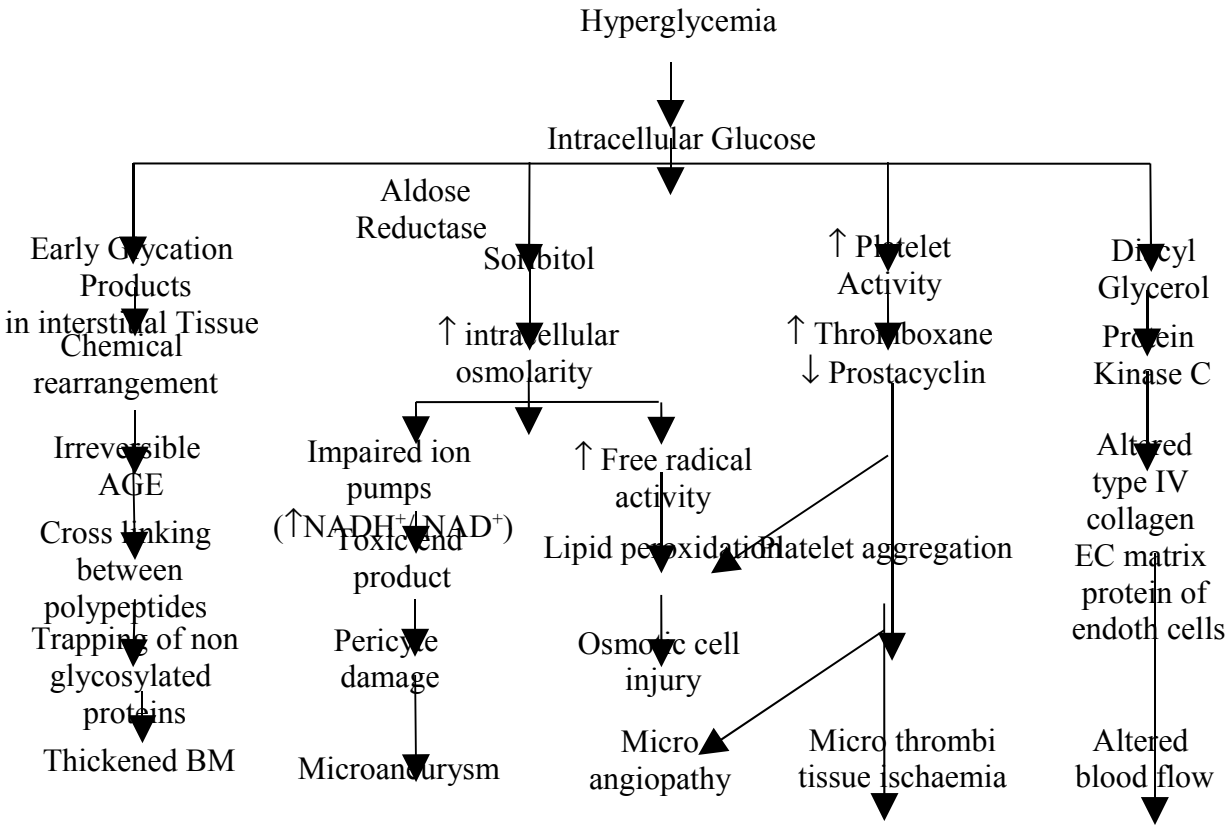
Relationship between HLA antigens expressed on the cell surface and the presence of retinopathy has already been documented. HLA – DR phenotypes 4/0, 3/0, and XX expression[S2,J9] is associated with increased proliferative retinopathy. Other HLA phenotypes conferring such increased risk include HLA B8, HLA B15 and HLA DR4.

OCULAR FACTORS

Myopia reduces the prevalence and severity of diabetic retinopathy[J9,10]. Retinochoroidal scarring from trauma or inflammatory disease, reduces the prevalence of retinopathy by decreasing the retinal metabolism and thereby decreasing the need for oxygen and the release of vasoproliferative factors.

PATHOGENESIS

There is a complicate interplay of various factors in the pathogenesis of diabetic retinopathy[S5].



I. BIOCHEMICAL MECHANISMS

1. Prolonged hyperglycemia [9]

It is the major etiologic agent in the micro vascular complications of diabetes mellitus. Three mechanisms seem plausible for diabetic retinopathy

i. Alteration in the expression of one or more genes resulting in increased amounts of altered gene products causing altered cell function.

ii. Non enzymatic glycation of proteins leading to cross linking and altered protein function[J11]. These products have very long cellular lifetime.

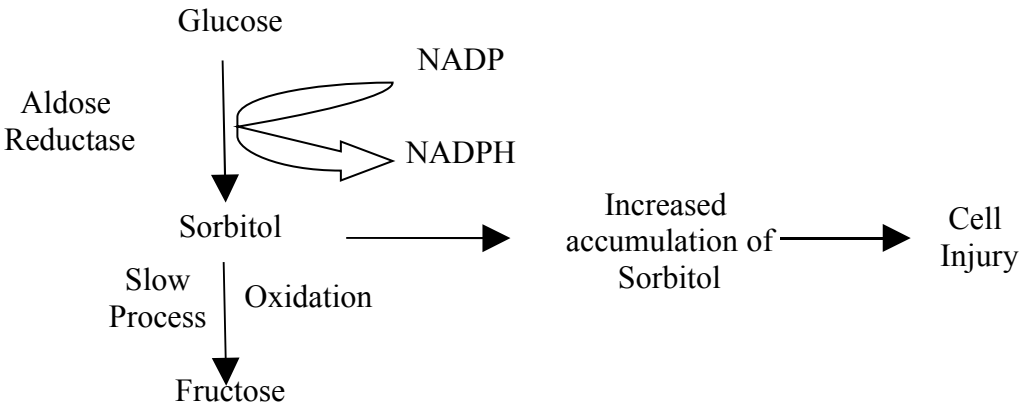
iii. Chronic hyperglycemia causes accelerated oxidative stress in cells resulting in toxic end products[J12]. Also increased activity of polyol pathway increases the

NADH/NAD+ ratio resulting in increased toxic end product, by a mechanism called hyperglycemic pseudo hypoxia[J13].

2. Sorbitol Pathway

Aldose sugars are converted to their respective alcohol by the enzyme aldose reductase and again to their key to sugars by dehydrogenase[S5].

Glucose is a relatively poor substrate for aldose reductase with high Km (binding constant). Under normal conditions, glucose is acted on by hexokinase to proceed on the glycolytic cycle.



In uncontrolled hyperglycemia, the hexokinase pathway gets saturated and glucose is acted upon by aldose reductase using NADP as cofactor, resulting in formation of excess sorbitol.

Further oxidation of sorbitol to fructose is a slow process resulting in building up of intracellular sorbitol leading on to cell damage and microvascular complications[J14].

3. Diacyl glycerol and protein kinase C

Hyperglycemia causes an increase in diacyl glycerol which inturn activates protein kinase C which causes alteration in expression of type IV collagen and extra cellular matrix proteins of endothelial cells[J15].

4. Vascular endothelial growth factor (VEGF)

VEGF is associated with proliferative retinopathy and maculopathy. Hypoxia stimulates the release of VEGF from the retinal and optic nerve glial cells of diabetics[J16].

II. RHEOLOGICAL MECHANISMS

1. Abnormality of Platelets

Increased platelet adhesion, increased aggregation, increased factor VIII – Von Willebrand factor and decreased lifespan of platelets also play a role in retinopathy development[S10].

2. Abnormalities of Red Blood Corpuscles (RBC)

In diabetic individuals, there is increased rouleaux formation and reduced deformability of RBC. This is presumed to be due to altered α_2 macroglobulin, haptoglobulin and increased fibrinogen.

PATHOLOGY

1. Capillary basement membrane thickening

Quantitative electron microscopic immunocytochemical studies show increased thickening of capillary basement membrane with an increase in type IV collagen[J17]. Studies show along with thickened basement membrane, there is Swiss Cheese vacuolisation and fibrillar collagen deposition. Certain functions served by basement membrane are deranged in diabetes[S2]. They are

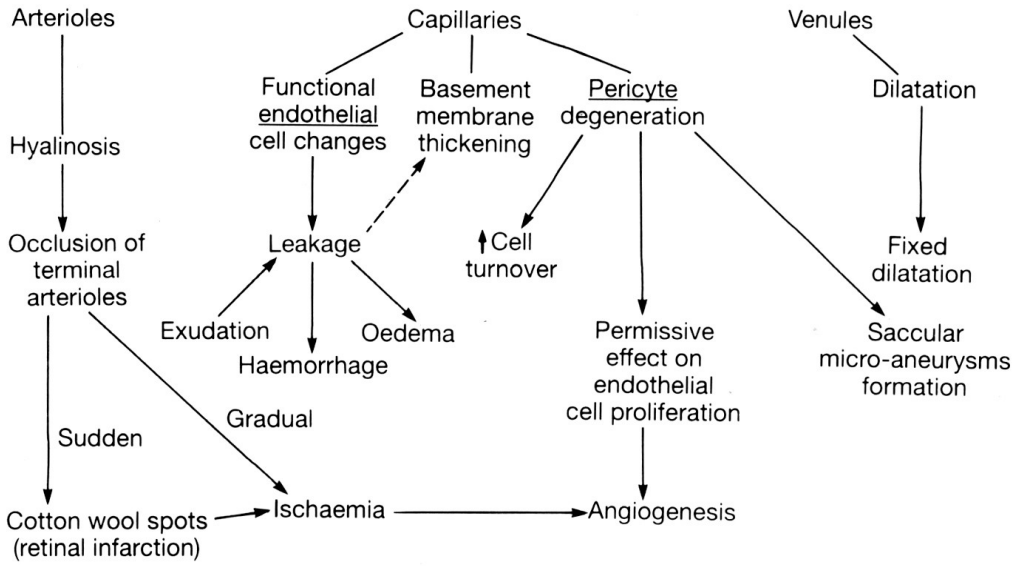
- Structural rigidity to blood vessels
- Filtration barrier for various molecules
- Barrier to vasoproliferation

2. Loss of microvascular intramural pericytes

The capillary wall has pericytes surrounding the endothelial cells. Of these, pericytes have aldose reductase rather than endothelial cells. Hence more sorbitol gests accumulated in pericytes causing damage to them. The drop out of pericytes is recognized as empty, balloon–like space bulging from the capillary wall[J18,19]. Normal pericyte to endothelial cell ratio is 1:1. In diabetic retinopathy this ratio gets altered[S7].

3. Microaneurysms

On trypsin digested retinal mounts, microaneurysms appear as hypercellular saccular outpouchings of capillary wall[J19,20]. Microaneuryms may hyalinize and get occluded with PAS-positive material.



4. Capillary acellularity

Complete loss of all cellular elements from retinal microvessels.

5. Breakdown of blood-retinal barrier

Breakdown of blood-retinal barrier occurs due to

- Opening of tight junctions (Zonulae occludentes) between adjacent microvascular endothelial processes[J20].
- Fenestration of endothelial cell cytoplasm.
- Increase in transport by endocytic vesicles.

6. Exudates

Hard exudates : 14 Hard, yellow, waxy lesions

consisting of lipid and proteinaceous material in Henle's layer.

Cotton wool exudates : Clusters of ganglion cell axons in the nerve fiber layer with bullous dilatation (cytoid bodies) at the site of ischaemia[S7].

7. Neovascularisation

The growth of new vessels in retina either on disc or elsewhere.

Stage 1 : The stage of naked vessels.

Fine, new vessels without supporting connective tissue arising from capillaries, grows in the plane of retina or invades vitreous.

Stage 2 : The stage of condensation of connective tissue

There is laying of connective tissue around the naked vessels which starts condensing.

Stage 3 : The stage of cicatrisation

Gradual reduction in number and size of new vessels is associated with an increase in the connective tissue density. This on contraction forms sheets and bands[S1].

CLASSIFICATION

Diabetic retinopathy is classified by Hirschberg as early as 1890. Later it was further classified by Ballantyne and Michaelson (1947 – 1962), Scott (1951), Alaerts and Slosse (1957) and Lee (1966). Duke Elder classified diabetic retinopathy as

a) Pre-retinopathy Stage

   Decreased activity in ERG and EOG

b) Simple Diabetic Retinopathy

   Appearance of microaneurysms, superficial and deep retinal haemorrhages, hard and soft exudates and vascular anomalies.

c) Proliferative Stage

   Neovascularisation over the disc or elsewhere, vitreous haemorrhage and complications like retinal detachment.

Early treatment diabetic retinopathy study (ETDRS) classifies[S4] nonproliferative diabetic retinopathy (NPDR) as follows

- Mild : atleast one microaneurysm, microaneurysms or haemorrhages < standard photograph 2A
- Moderate : microaneurysms & haemorrhages ≥ standard photograph 2A, soft exudates, venous beading and intraretinal microvascular anomalies (IRMA)

- Severe : any one of the following

  (4:2:1 rule) microaneurysms / haemorrhages in 4 quadrants or venous beading in ≥2 quadrants or IRMA in one quadrant.

- Very severe : any two or more of the above mentioned [J21].

ETDRS classifies clinically significant macular edema as

1. Thickening of retina at / within 500 μ from center of the macula or
2. Hard exudates at / within 500μ from center of the macula with adjacent retinal thickening or
3. zone of retinal thickening of one disc area or larger, a part of it is within, one disc diameter of the center of macula[J22]

Diabetic Retinopathy Study classifies proliferative diabetic retinopathy (PDR) as

- Early : New vessels on the disc / elsewhere
- High risk : New vessels over disc ≥1/3–1/4 disc area or

  New vessels over disc and preretinal or vitreous haemorrhage or

  New vessels elsewhere ≥1/2 disc area and preretinal or vitreous haemorrhage.

STUDIES ON DIABETIC RETINOPATHY

Early treatment diabetic retinopathy study (ETDRS)

This is a randomised clinical trial to ascertain the effect of laser in diabetic retinopathy.

Results :

- Aspirin did not alter the progression of diabetic retinopathy or increase vitreous haemorrhage.
- Early PRP is not indicated in eyes with mild - moderate retinopathy.
- Early PRP resulted in reduction in the risk of severe visual loss.
- Focal photocoagulation for diabetic macular edema reduced the risk of moderate visual loss and increased moderate visual gain.

Diabetic Retinopathy Study (DRS)

This clinical trial evaluated the effect of PRP in diabetic retinopathy. Results :

- Xenon arc photocoagulation caused a $\geq$ 50% reduction in the rates of severe visual loss (SVL).
- Treated eyes with high risk PDR achieved the greatest benefit.

United Kingdom Prospected Diabetic retinopathy Study(UKPDS)

This is a randomised control trial which was conducted to evaluate the effectiveness of intense control of blood pressure and blood glucose in type II diabetic patients.

Results :

Intense control of blood pressure and blood glucose slowed the progression of retinopathy and reduced the risk of microvascular complications.

Diabetes Control and Complications Trial (DCCT)

This study was conducted with the aim to evaluate the effectiveness of intense control of blood glucose in type I diabetes.

Results :

- Intensive control of blood glucose reduced the risk of developing retinopathy by 76% and slowed the progression by 54%.
- It reduced the risk of neuropathy by 60% and nephropathy by 54%.

Diabetic Retinopathy Vitrectomy Study (DRVS)

This randomised prospective clinical trail investigated the role of vitrectomy in diabetic retinopathy.

Results :

Early vitrectomy in type I diabetics had clear benefit over deferral group, especially severe PDR benefited more.

Wisconsin Epidemiologic Study on Diabetic Retinopathy (WESDR)

This study depicted the prevalence and risk factors associated with diabetic retinopathy.

CLINICAL FEATURES

I. NON PROLIFERATIVE DIABETIC RETINOPATHY

The pathological processes in NPDR include retinal capillary micro aneurysm, increased vascular permeability and eventual capillary closure.

1. Microaneurysm

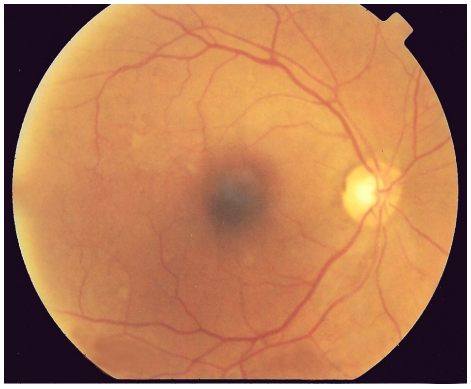
Meckanzie and Nettleship were the first to note microaneurysms.They appear as deep red dots varying from 15μm to 60 μm in diameter. It is most common in posterior pole and appears & disappears with time.

Weakness of capillary wall, loss of pericytes, release of vasoproliferative factor, abnormalities of adjacent retina and increased intra luminal pressure [J18] play a role in its development.

2. Hard exudates

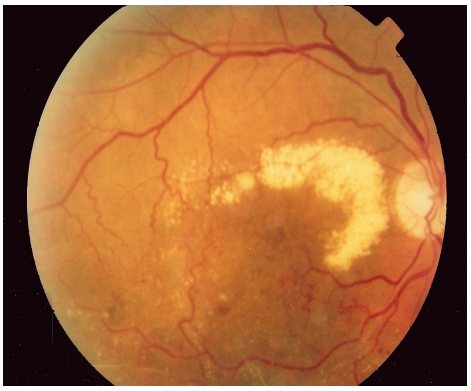
With progressing retinopathy, vascular permeability of retinal capillaries increases resulting in leakage of serum and lipids resulting in hard exudates and macular edema.Hard exudates are yellow - white intra retinal lipid deposits located at the border of edematous and nonedematous retina. They present as clusters, plaque and cricinate / ring patterns.

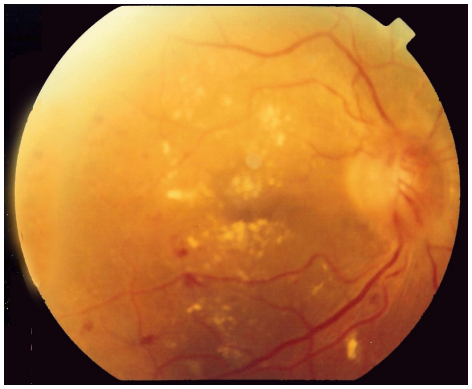
MILD NPDR **MODERATE NPDR**



SEVERE NPDR

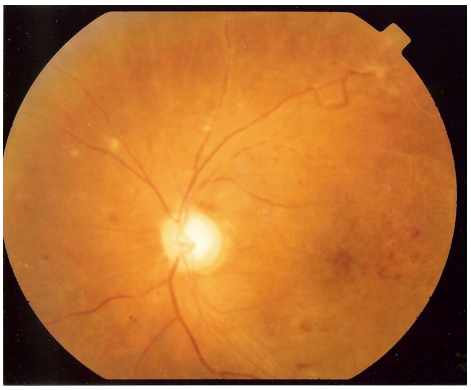
VERY SEVERE NPDR



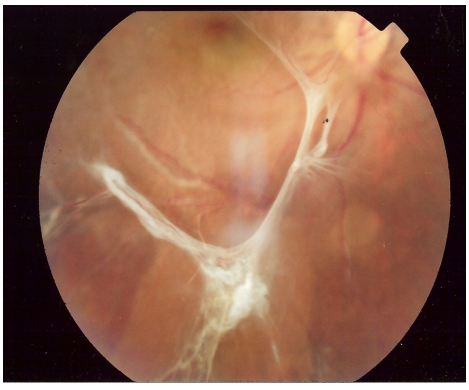


VENOUS LOOPING

PDR



ADVANCED PDR



MACULOPATHY

3. Intra retinal haemorrhages

Superficial haemorrhages : Flame shaped due to the accumulation of blood in the superficial retinal layers parallel to the coursing nerve fibers[S6].

Deep haemorrhages : Dot and blot in the inner nuclear and outer plexiform layers and its breaks through the confines of Muller cell processes.

4. Capillary closure

Capillary closure results in patchy areas of nonpurfused retina with clusters of microaneurysms, cotton wool spots, IRMA, haemorrhages and venous beading.

Cotton wool spots : White patches with fraying borders merging into the retina, present in areas of microvascular occlusion and nonperfusion.

IRMA : Intra retinal vascular shunts and they do not leak on fluorescein angiography.

II. MACULOPATHY

It is one of the major causes of visual loss in diabetic retinopathy[S2]. It is more commonly associated with NIDDM and older patients. Maculopathy presents either as macular edema or macular ischaemia[S4]. Macular edema can present as focal or diffuse edema which may be clinically significant.

Focal macular edema :

- areas of leakage from micro aneurysm and IRMA.
- associated with rings of hard exudates and microaneurysms[s4,,3].

Diffuse macular edema :

- has diffuse retinal thickening

- wide spread retinal capillary abnormality with diffuse leakage dueto extensive breakdown of blood retinal barrier.
- associated often with cystoid macular edema.

Macular Ischaemia :

- capillary nonperfusion
- microaneurysm clusters at the margins of nonperfusion
- more visual loss with clinically normal appearing macula
- enlargement of foveal avascular zone[2]
- if >1000 μm in diameter, severe visual loss ensues.

Clinically significant macular edema (CSME) :

The CSME was defined by ETDRS which helps in its management. 10% of diabetics have macular edema and in 40% of these, the center of the macular is involved and have significant visual loss[J23].

II. PROLIFERATIVE DIABETIC RETINOPATHY (PDR)

The appearance of new vessels over disc or elsewhere in the retina is considered as PDR. The most plausible explanation for endothelial proliferation is ischaemia of inner retinal layers secondary to closure of parts of retinal capillary bed [J24,25,26]. Based on the location the new vessels can be grouped as

- New vessels involving the retina but sparing the disc

- New vessels involving the disc
- New vessels in the anterior chamber angle

New vessels are seen commonly within 45 degrees of optic disc [S4,J27,28]. 45% have new vessels outside the optic zone alone and 45% have new vessels both in the optic zone and outside it[J30].

STAGES OF PDR

Stage of proliferation

- Fine new vessels at the disc margin of size one eighth to one fourth that of major retinal vein.
- New vessels more frequently occur along superotemporal vein [J27,28] and grow along retinal plane or invade vitreous either radially or irregularly.
- Deposition of fibrous tissue around blood vessels.

Stage of regression

Decrease in the caliber and the number of vessels occurs and it is followed by replacement of them with fibrous tissue [J29,30].

PDR can be classified as early PDR, high risk PDR and advanced stage, where there is extensive vitreous haemorrhage precluding grading, retinal detachment involving macula or phthisis bulbi or enucleation secondary to a complication of diabetic retinopathy.

SEQUELAE

1.Contraction of vitreous

- Thickened posterior vitreous adjacent to the site of new vessels with fibrous tissue along its posterior surface.
- Vitreous contraction with the vector pulling the posterior vitreous forward.
- Eventual posterior vitreous detachment commonly occurs along superotemporal vessels, temporal to macula and above/below the disc. The traction on new vessels can lead to vitreous haemorrhage.

2. Tractional retinal detachment

The occurrence and severity of retinal detachment is influenced by the timing and degree of vitreous shrinkage and vitroretinal adhesions. With contraction of fibrovascular proliferation, distortion and displacement of macula occurs. Macula is usually dragged nasally and vertically[J31].

3. Involutional diabetic retinopathy

With complete vitreous contraction and detachment, marked reduction in the caliber of retinal vessels is characteristic. There is severe retinal ischaemia, resulting in marked visual loss [J32,33].

CLINICAL EVALUATION

Visual Acuity

The evaluation of retinopathy patients starts with assessing visual acuity. Refraction is to be done in all cases of diabetic retinopathy and best corrected visual acuity must be documented.

Colour vision

In diabetes, the sensitivity of blue cones is depressed and the common defect observed is in the blue-yellow range. It is best detected by fransworth munsell hundred hue test.

Fields

Examination of fields by perimetry shows areas of scotoma which represent the corresponding abnormal areas of retina.

Intraocular pressure

IOP is measured in diabetics to rule out neovascular glaucoma.

Ophthalmoscopy

By direct ophthalmoscopy, detailed fundus examination is carried out. Even though the area visualized is smaller, it provides a good magnification for the details to

be seen clearly. Indirect Ophthalmoscopy is carried out to visualize the entire retina including peripheral retina.

Slit Lamp Examination

Using slit lamp biomicroscope, the retinal examination and angle study are done with Goldmann 3 mirror lens, +78D and 90D lens.

Macular Function Tests

The assessment of macula is recommended in all cases of maculopathy. The following tests can be performed.

- 2 point discrimination
- Photo stress Test
- Amsler grid test
- Blue field entoptoscope

Flourescein angiography

Indications in diabetic retinopathy

- to define the focal and diffuse leaks in diabetic maculopathy
- to delineate the extent of ischaemic zone in maculopathy
- to locate areas of capillary nonperfusion and leakage from new vessels in proliferative stage

- to identify the persistence, progression or resolution of macular edema following laser photocoagulation.
- to detect small microaneurysms <20 microns

The property of fluorescein to absorb higher energy, shorter wavelength blue light and to emit lesser energy, longer wavelength, green light, with this change occurring over a brief period of time ($<10^{-8}$) is called fluorescence. This property is used in fluorescein angiography[S8].

Features

Microaneurysms	:	well defined hyperfluorescence against dark choroidal background [J34].
Retinal haemorrhages	:	well defined areas of hypoflourscence.
Superficial	:	blocked retinal & choroidal fluorescence.
Deep	:	blocked choroidal fluorescence alone
Hard exudates	:	areas of blocked fluorescence
Cotton wool spots	:	areas of blocked fluorescence.
Capillary nonperfusion	:	well defined areas of hypofluorescence between retinal vessels.

non visibility of capillaries.

NVD/NVE : increasing intense hyperfluorescence due to leakage [J35].

Focal macular edema : focal leaks from microaneurysms with blocked fluorescence from hard exudates and haemorrhages.

Diffuse macular edema : dilatation of capillaries and diffuse leaks in early venous phase. Floral pattern in cystoid macular edema.

Ischaemic maculopathy : enlarged and irregular foveal avascular zone [J36], capillary dropouts in perifoveal area.

MANAGEMENT

EVALUATION BIOCHEMICAL PARAMETERS

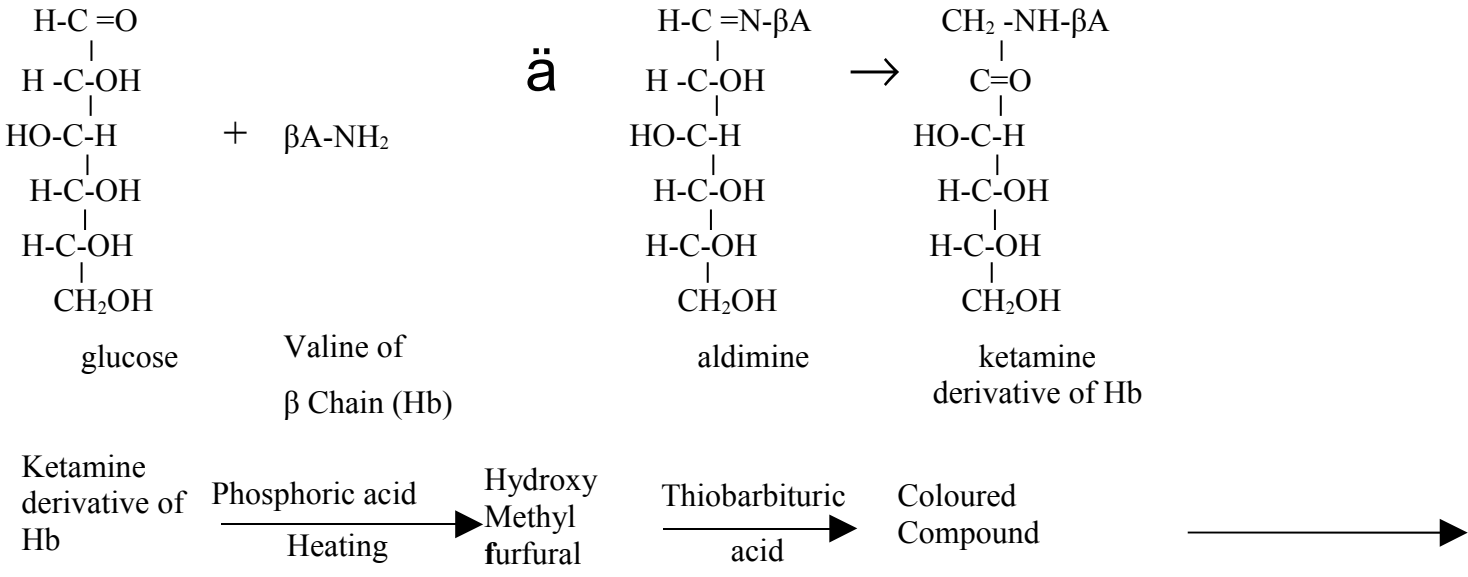
Estimation of Fasting Blood Glucose

This is done by ortho-toludine method.

Glycosylated hemoglobin (HbA_{1c})

Estimation of HbA_{1c} is done using high pressure liquid chromatography.

Principle :



This coloured compound is then measured.

Total Cholesterol (Modified Salkowski's Method– Wybenga Method)

The principle of this reaction is that cholesterol reacts with ferric chloride ions in acetic acid followed by sulphuric acid. This method is modified by Wybenga and this is used to estimate total cholesterol.

HDL Cholesterol (Loper and Virella)

In this procedure, the VLDL, chylomicrons and LDL are separated by phosphotungstate in the presence of Mg^{+} ions and HDL cholesterol is estimated from the supernatant.

Triglycerides (Foster and Dunn) Hantzsch Reaction

Triglycerides are extracted by heptane isopropanol from phospholipids and are saponified by potassium hydroxide. The liberated glycerol is oxidised to formaldehyde which then combines with acetyl acetone and ammonia to give a dihydrobutidine derivative. It is then measured.

TREATMENT

The treatment depends on the type and severity of retinopathy.

NONPROLIFERATIVE RETINOPATHY

For mild and moderate NPDR, strict adherence to normal levels of glycemia, blood pressure and lipid status is the mainstay of effective treatment. Scatter laser photocoagulation is generally not recommended[S4].

The Early Treatment Diabetic Retinopathy Study and the Diabetic Retinopathy Study recommend photocoagulation as the treatment of choice for severe and progressive form of retinopathy and clinically significant macular edema.

Severe NPDR

For severe NPDR, scatter laser treatment is appropriate when

- Disease process is progressing rapidly
- Close follow-up unlikely.

Macular edema

ETDRS demonstrated that retinal laser therapy applied to macula reduces the risk of substantial worsening of vision by 50%.

Focal macular edema :

Direct laser using green or yellow wavelength applied over microaneurysms that are between 500-3000µm from the center of the macula[S9]. Parameters for focal treatment

Spot size : 50-100µm

Duration : ≤0.1s

Power : sufficient to cause blanching of microaneurysm / RPE

Diffuse macular edema :

A light intensity grid pattern using green or yellow wavelength to all areas of diffuse leakage >500µm from the center of macula and 500µm from the temporal margin of the optic disc. Parameters for grid pattern.

Spot size : 50-100µm

Duration : ≤0.1s

Power : sufficient to cause blanching of RPE

Spots are placed at least one burn width apart. CSME is more benefited from laser.

Ischaemic maculopathy :

As the macula has capillary non perfusion, focal or grid laser is not recommended.

PROLIFERATIVE DIABETIC RETINOPATHY

Medical management:

The principal goal is controlling both systemic and local factors that influence the

progression from NPDR to PDR. This includes good glycemic control, control of hypertension, renal disease and coronary artery disease.

DCCT and UKPDS have documented that intensive glycemic control is associated with a reduced risk of newly diagnosed retinopathy and a reduced progression of existing retinopathy.

Panretinal photocoagulation (PRP) :

PRP is done to cause regression of existing new vessels to prevent progressive neovascularisation[S11].

ETDRS and DRS study model, the parameters are

Number of burns	:	≥1200
Spot size	:	500µm
Duration	:	0.1.

Spots are placed at least ½ burn width apart and the number of sessions are more than two. The rate of severe visual loss is reduced from 16% in untreated eyes over two years to 6% in treated eyes, documenting a reduction of 57%[J37].

Surgical management

Surgical intervention is the mainstay of contemporary management for vitreous haemorrhage and tractional retinal detachment[J38].Type I patients with severe vitreous haemorrhage show an advantage due to early vitrectomy[J39].

Indications for pars plana vitrectomy :

- Dense non clearing vitreous haemorrhage
- Tractional retinal detachment threatening macula
- Combined tractional and rhegamatogenous detachment
- Diffuse macular edema with post hyaloid traction
- recurrent vitreous haemorrhage

Recent Advances

In patients with refractory CSME, intravitreal administration of corticosteroids showed to be useful. Currently, several drug delivery modalities are in clinical trials to investigate their efficacy.

ETDRS RECOMMENDED OCULAR EXAMINATION SCHEDULE[S6]

Age at onset	Time recommended	Routine minimal follow up(in the absence of retinopathy)
≤30 years	5 years of diabetes	yearly
>30years	At the time of diagnosis	yearly
Pregnancy	Before conception/first trimester	3 monthly

RECOMMENDED FOLLOW-UP SCHEDULE IN DIABETIC RETINOPATHY PATIENTS

Retinal Abnormality	Suggested Follow-up
Normal or rare micro aneurysms	Annually
Mild NPDR	Every 9 months
Moderate NPDR	Every 6 months
Severe NPDR	Every 4 months
CSME	Every 2-4 months
PDR	Every 2-3 months

LEVELS OF PRVEVENTION OF DIABETIC RETINOPATHY

The visual loss due to diabetes can be prevented by intervening at various stages of the diseases.

Primary prevention

Once the diagnosis of diabetes is made, strict control of glycemic status by diet, exercise and drugs .Periodic ophthalmic examination must be carried out. Referral of the diabetic individuals to ophthalmologists regularly or as soon as signs of micro angiopathy like microalbuminuria sets in.

Secondary prevention

Blindness can be prevented in NPDR patients by the modification of the risk factors. Fluorescein angiography is done to find out the type of maculopathy at initial stages. Laser photocoagulation is given for maculopathy and PDR to prevent visual loss.

Tertiary prevention

When the patient is in advanced proliferative stage, relevant surgical treatment given. Further visual rehabilitation is given by low vision aids.

Aim of the Study

AIM OF THE STUDY

1. To study the magnitude of diabetic retinopathy in diabetic individuals with relation to age and sex of the individual and duration of diabetes.
2. To assess the possible risk factors associated with diabetic retinopathy.
3. To assess the associated systemic disorders in diabetic retinopathy.
4. To assess the relationship of the biochemical parameters like baseline lipid, fasting blood glucose and HbA_{1c} to diabetic retinopathy.
5. To assess the incidence of maculopathy in diabetic retinopathy.
6. To assess the benefits of laser in diabetic retinopathy.

Materials and Methods

MATERIALS AND METHODS

The diabetic individuals reporting or being referred to Coimbatore Medical College Hospital, Eye Department during the period of January 2006 to October 2007 were taken into the study.

This included both type I and type II diabetic individuals of either sex. Pregnant women and children were excluded from the study. A total of 90 visually symptomatic diabetic patients with retinopathy were evaluated.

A careful history of the patients regarding their age and sex, duration of diabetes mellitus, risk factors, associated systemic disorders like nephropathy, hypertension, coronary artery disease (CAD) and neuropathy was recorded. The nature of the treatment of diabetes was noted.

Materials used

1. Snellen's visual acuity chart
2. Schiotz tonometer
3. Haag Streit / Carl Zeiss slit lamp
4. Direct ophthalmoscope
5. Indirect ophthalmoscope
6. Goldmann three mirror, +78D and 90D lens
7. Topcon fundus camera

The following investigations were done to evaluate the risk factors and systemic disorders which are associated with diabetic retinopathy

1. Fasting blood sugar (Orthotoludine method)
2. Glycosylated hemoglobin (high pressure liquid chromatography)
3. Total cholesterol (modified Salkowski – Wybenga Method)
4. HDL (Loper and Virella)
5. TGL (Foster – Dunn, Hantzsch Reaction)
6. LDL(enzymatic method)
7. Blood Urea (urease method)
8. Serum creatinine (Jasse kinetic method)
9. Urine – albumin, sugar

Blood Pressure was measured and CAD was diagnosed based on the history of documented myocardial infarction and drug treatment for CAD. Neuropathy was diagnosed based on the history and its treatment.

Methods

Work up started with testing the unaided visual acuity of each eye separately using Snellen's chart. Using slit lamp biomicroscopy, the anterior segment was evaluated. Intraocular pressure measured using Schiotz tonometer. Pupils were dilated with tropicamide eye drops and retinoscopy and refraction done. The best corrected visual acuity was noted. The retinal examination was done with direct and indirect ophthalmoscopes, +78D and Goldmann three mirror lens. Fundus photograph taken using Topcon fundus camera. Fluorescein angiography was done with special emphasis

to

- Leaking micro aneurysms and their location
- Leaking new vessels
- Focal and diffuse leaks in macula
- Presence of ischaemia in macula

Criteria for Photocoagulation

1. Focal Photocoagulation

- For patients with focal leaks especially in parafoveal and perifoveal areas.
- Done with argongreel laser of 50-100μ spot size for 0.05-0.1s.

2. Grid Photocoagulation

- For patients with diffuse exudation and clinically significant macular edema.
- 100μ spot closed to fovea and 200μ spot away from fovea with moderate intensity.

3. Panretinal (scatter) Photocoagulation

- For eyes with rapidly progressing severe NPDR, proliferative retinopathy with well established revascularization over disc / elsewhere.
- Very severe NPDR with poor compliance.
- 1200 – 1600 burns of size upto 500μ given, occupying the posterior pole sparing macula.

- For combined maculopathy with diabetic retinopathy that is approaching high risk PDR, a prior focal photocoagulation for edema given followed by PRP.

Blood pressure was recorded in sitting posture. Fasting blood sugar, glycosylated hemoglobin, lipid profile, blood urea, serum creatinine and urine routine done.

Follow up

Patients are followed up every two months with special emphasis laid on fundus evaluation for regression existing new vessels, appearance of new vessels, decrease in retinal haemorrhage and exudates and detect early iris neovascularisation by slit lamp examination.

Observation

OBSERVATION

In our study conducted from January 2006 to October 2007, 270 diabetic individuals reported to eye department, out of which 90 visually symptomatic diabetics with retinopathy of varying severity were taken into study. In the evaluation of biochemical parameters the values above the following levels are considered as abnormal[S12,J40].

- Fasting blood glucose = 126mg / dl
- HbA_{1c} = 6%
- Total cholesterol = 200mg / dl
- LDL cholesterol = 100mg / dl
- HDL cholesterol <40mg / dl
- Triglycerides = 160mg / dl
- Blood urea = 40 mg / dl
- Serum creatinine >1.5 mg / dl
- Blood pressure = 140/90mmHg

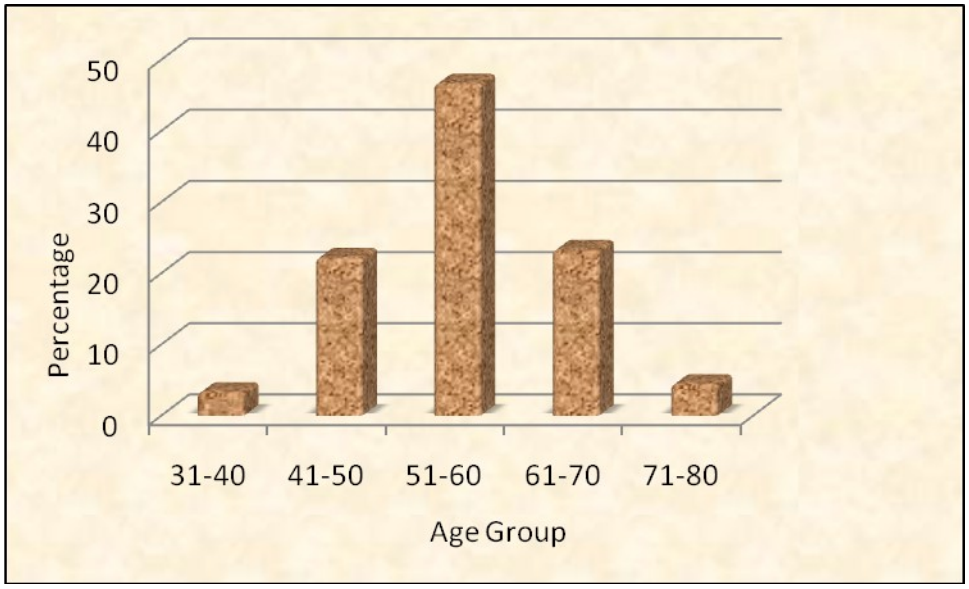
Statistical Tools

The parameters under study were compared by applying Z test i.e., test based on normal distribution, since the sample size was large (n>30). The results were obtained using SPPS 11 version package. The data collected were analysed on the basis of descriptive statistics, mean and standard deviation. The graphs and diagrams were also used to represent the data. Microsoft word and excel had been used to generate graphs and tables.

Table – 1 : Age Distribution

Age Group	Number (n)	Percentage (%)
31-40	3	3.33
41-50	20	22.22
51-60	42	46.67
61-70	21	23.33
71-80	4	4.45

Figure showing the percentage of Age Distribution

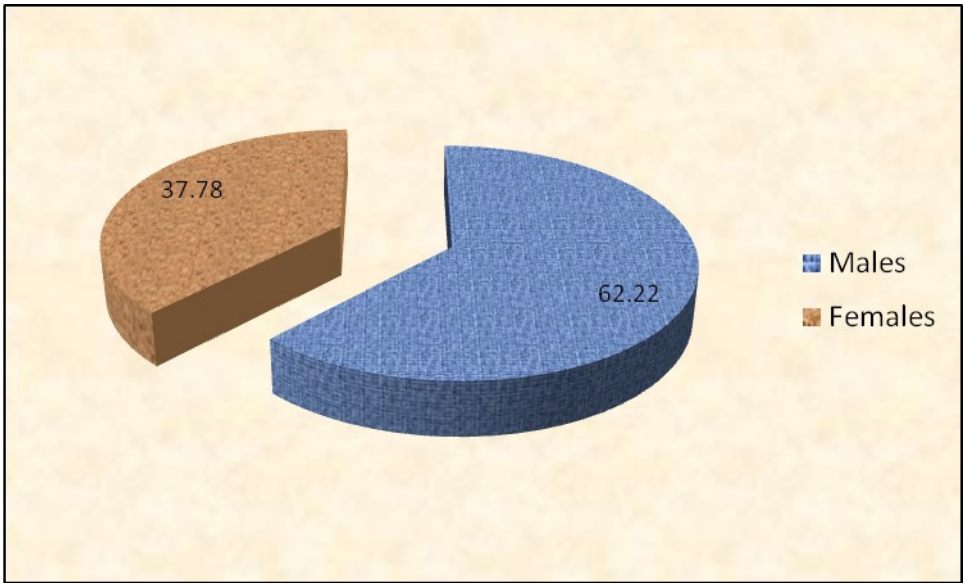


In our study, the predominant age group affected is 51-60 years (46.67%) followed by 61-70 years (23.33%) least involved group is less than 40 years. In the study conducted by Khandekar et al., 2003[J41]showed that the retinopathy rate was common in 50-59 years followed by 60-69 years.

Table – 2 : Gender Distribution

Gender	Number (n)	Percentage (%)
Males	56	62.22
Females	34	37.78

Figure showing the percentage of Gender Distribution

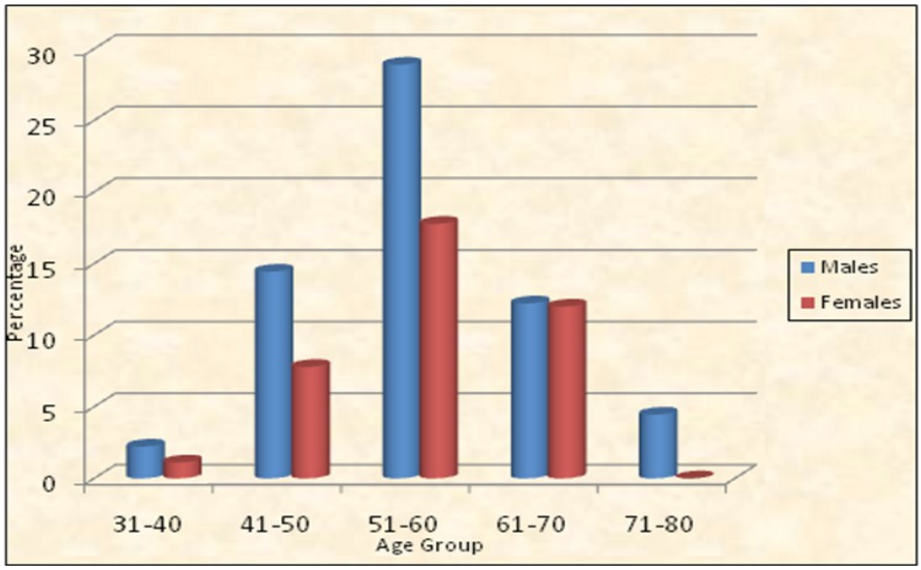


In our study, diabetic retinopathy was prevalent more in males(62.22%). The sex ratio between males and females was 1.6 : 1. This is comparable to Bodansky et al 1982[J44], which showed a sex ratio between males and females as 2:1.

Table – 3 : Age - Gender Distribution

Age Group	Number (n)		Percentage (%)	
	Males	Females	Males	Females
31-40	2	1	2.22	1.11
41-50	13	7	14.44	7.78
51-60	26	16	28.89	17.78
61-70	11	10	12.22	11.11
71-80	4	-	4.45	-

Figure showing the percentage of Age - Gender Distribution

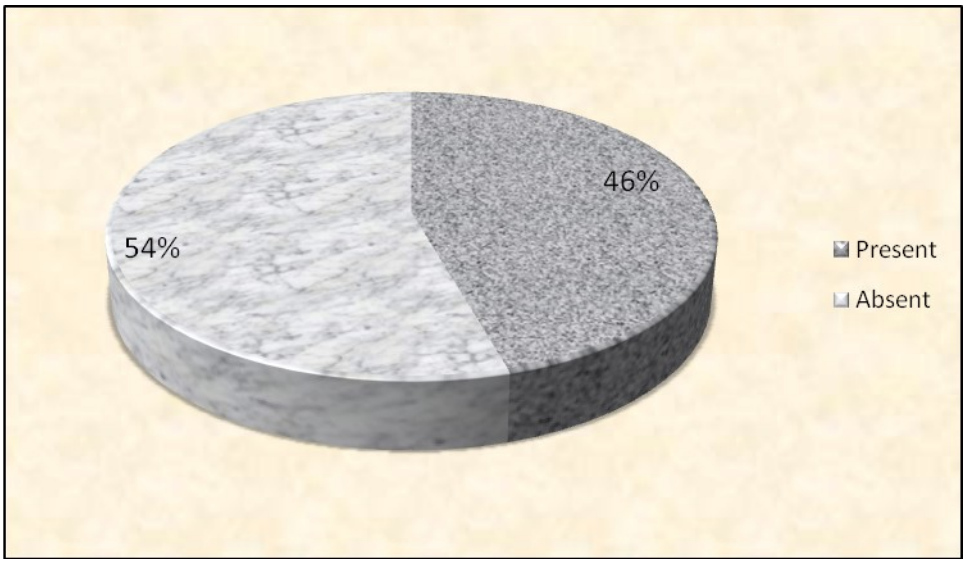


In both males and females predominant involved is 51-60 years (28.89% of males and 17.78% of females). In males the next common age group involved is 41-50 years (14.44%), whereas in females it is between 61-70 years (11.11%).

Table – 4 : Family history of diabetes

Family History	Number (n)	Percentage (%)
Present	41	45.56
Absent	49	54.44

Figure showing the percentage of Family history of diabetes

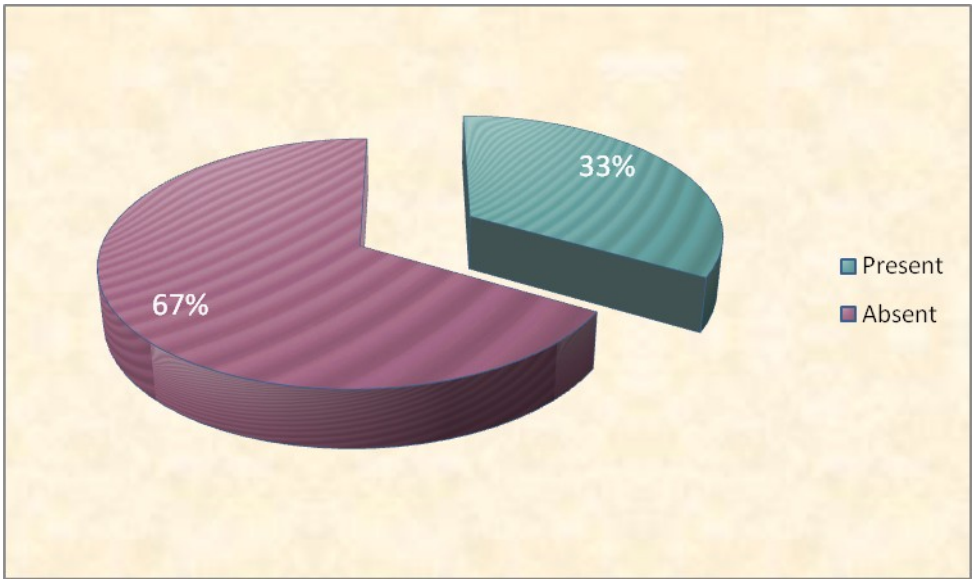


In our study, most of the patients (54.44%) did not show positive family history whereas 45.56% of diabetics had family history of diabetes. Out of the 41 diabetics having positive family history, 16 (39%) had nonproliferative diabetic retinopathy and 25 (61%) had proliferative retinopathy.

`Table – 5 : Distribution of Diabetic Retinopathy

Retinopathy	Number (n=270)	Percentage (%)
Present	90	33.33
Absent	180	66.67

Figure showing the percentage of Distribution of Diabetic Retinopathy

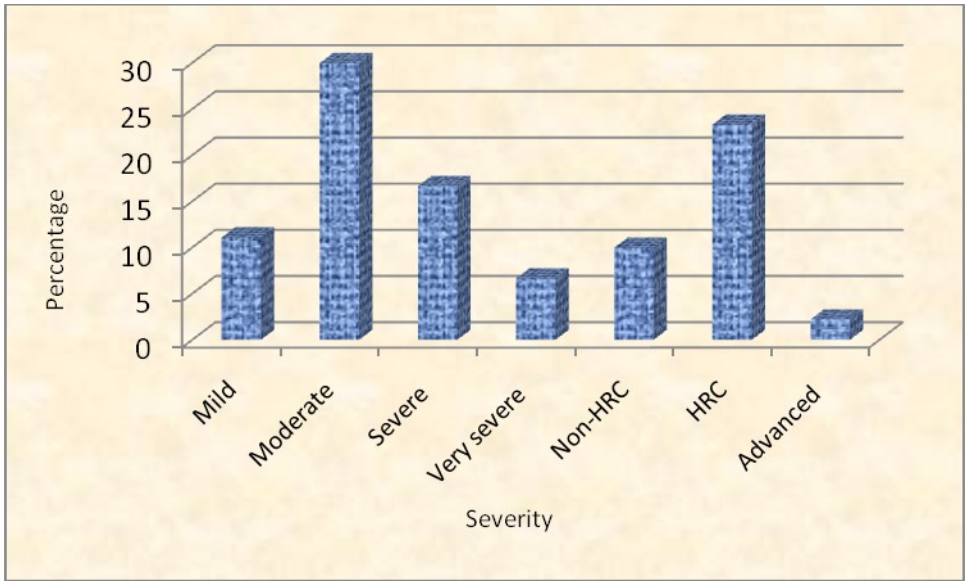


Out of the 270 diabetic patients reported to our department, 90 (33.33%) had diabetic retinopathy of varying severity. 180 (66.67%) did not show any evidence of diabetic retinopathy. It can be compared to the study conducted by Agrawal et al, 2003[J43] which showed 28.9% retinopathy.

Table – 6 : Severity of Diabetic Retinopathy

Severity	Number (n=90)	Percentage (%)	Total	
			n	%
NPDR				
Mild	10	11.11	58	64.44
Moderate	27	30		
Severe	15	16.67		
Very severe	6	6.67		
PDR				
Non-HRC	9	10	32	35.56
HRC	21	23.33		
Advanced	2	2.22		

Figure showing the severity of Diabetic Retinopathy

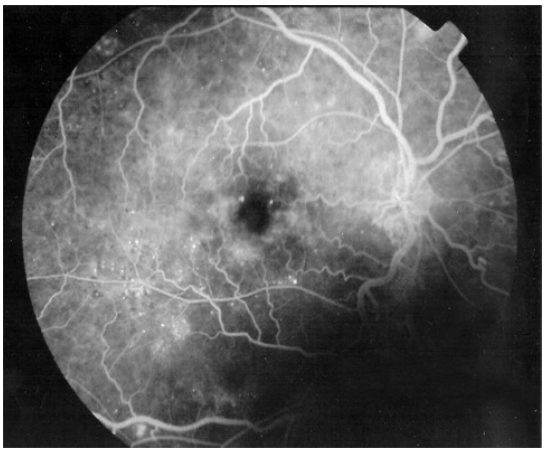


In a total of 90 patients with diabetic retinopathy, 58 (64.44%) had

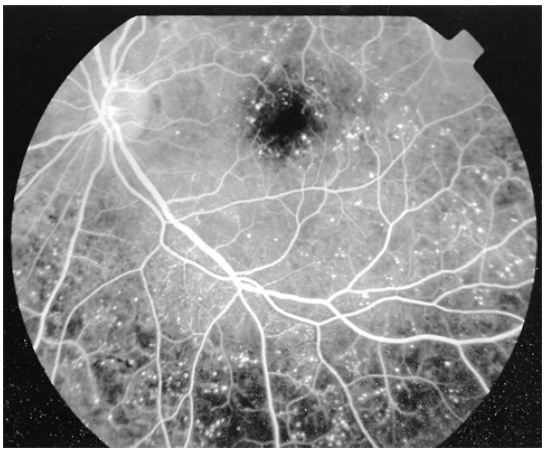
nonproliferative retinopathy and 32 (35.56%) had proliferative retinopathy. Of the NPDR, the prevalence of mild, moderate, severe and very severe retinopathy is 11.11%, 30%, 16.67% and 6.67% respectively. Among 32 PDR patients, 21 (23.33%) presented with high risk characteristics, whereas 9 (10%) presented with non high risk characteristics. 2 patients (2.22%) were in advanced stage.

FLUORESCEIN ANGIOGRAPHY

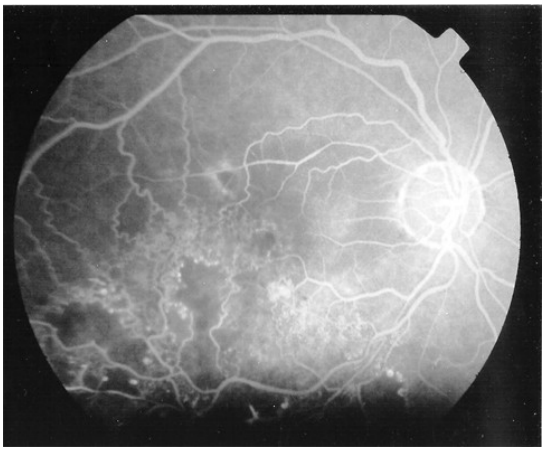
MILD NPDR



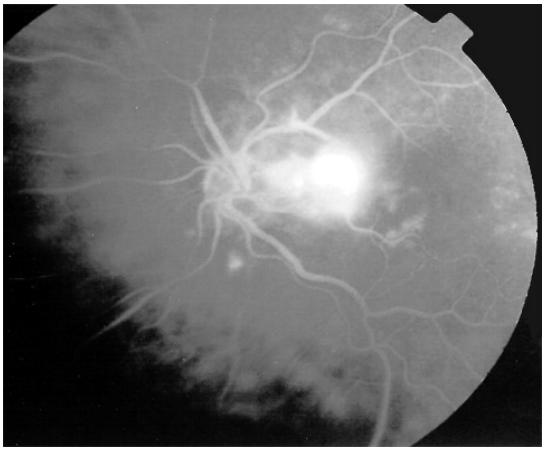
MODERATE NPDR



SEVERE NPDR



PDR - NVD



POST LASER

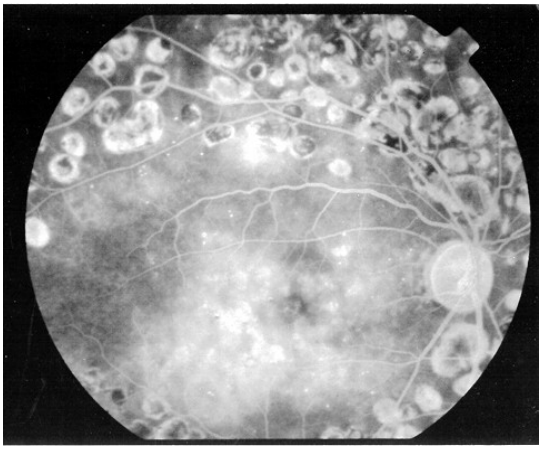
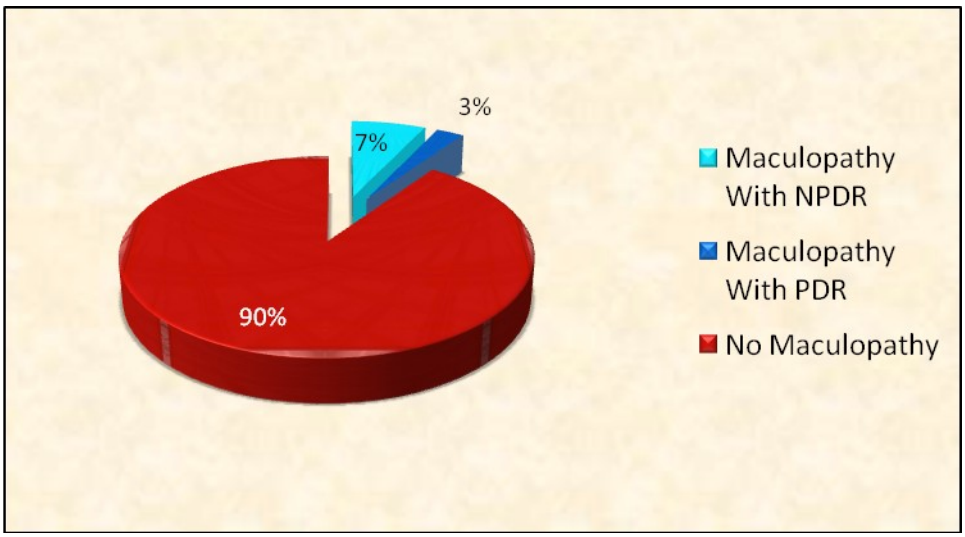


Table – 7 : Incidence of Maculopathy

Maculopathy Status	Number (n=270)	Percentage (%)	Total	
			n	%
Maculopathy				
With NPDR	19	7.04	26	9.63
With PDR	7	2.59		
No Maculopathy	244	90.37	244	90.37

Figure showing the percentage of Incidence of Maculopathy

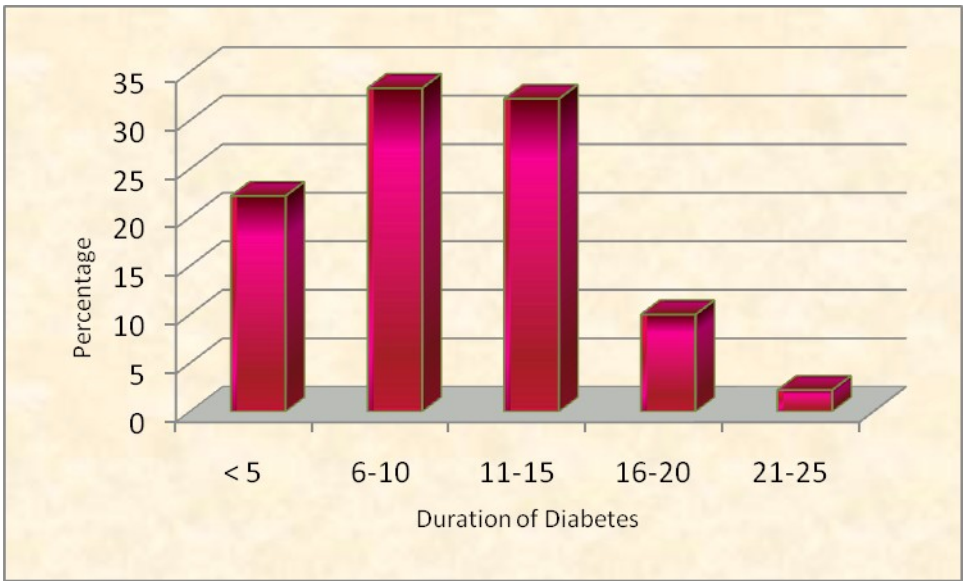


In our study, 26 (9.63%) individuals had maculopathy. This correlated with the study conducted by Khandekar et al 2003[J41]. It was associated more with NPDR in 19 individuals (7.04%) then with PDR (2.59%).

Table – 8 : Duration of Diabetes

Duration (in years)	Number (n=90)	Percentage (%)
≤ 5	20	22.22
6-10	30	33.33
11-15	29	32.22
16-20	9	10.00
21-25	2	2.22

Figure showing the percentage of Duration of Diabetes

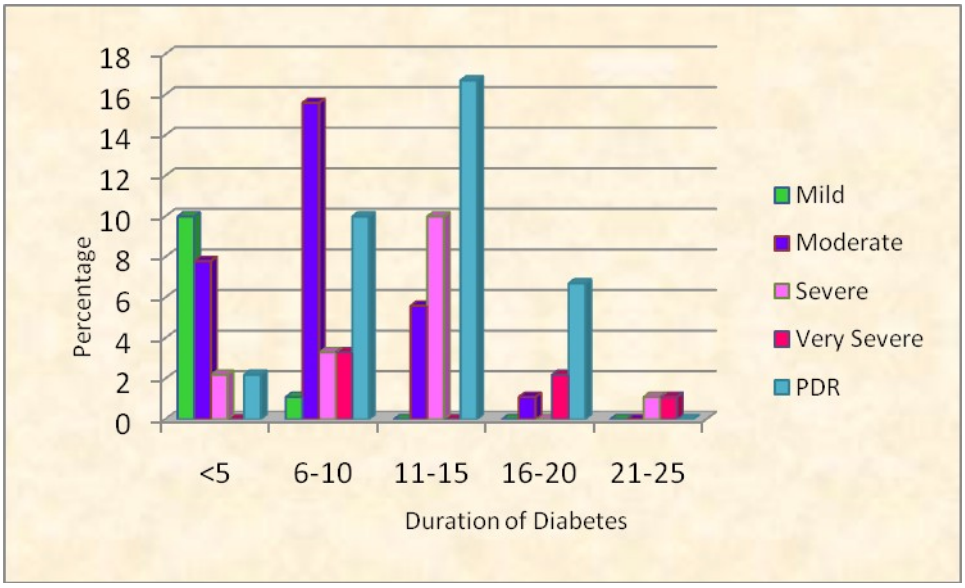


In less than 5 years duration of diabetes, only 20 (22.22%) had retinopathy. Of 90 individuals with retinopathy, almost one third (33.33%) presented with retinopathy in 6-10 years of diabetes. This is closely followed by 29 individuals (32.32%) presenting with retinopathy in 11-15 years of diabetes.

Table – 9 : Duration of diabetes and severity of retinopathy

Severity	Duration in years				
	≤5	6-10	11-15	16-20	21-25
Mild n=10 (%)	9 (10%)	1 (1.1%)	-	-	-
Moderate n=27 (%)	7 (7.8%)	14 (15.6%)	5 (5.6%)	1 (1.1%)	-
Severe n=15 (%)	2 (2.2%)	3 (3.3%)	9 (10%)	-	1 (1.1%)
Very Severe n=6 (%)	-	3 (3.3%)	-	2 (2.2%)	1 (1.1%)
PDR n=32 (%)	2 (2.2%)	9 (10%)	15 (16.7%)	6 (6.7%)	-

Figure showing the percentage of Duration of diabetes and severity of retinopathy



As the duration of diabetes increased, the severity of retinopathy also increased.

At less than 5 years of diabetes, nonproliferative changes predominate (20%) and proliferative changes occurred in 2.2%. When duration of diabetes increased to 15 years, proliferative changes increased to 16.7%. This correlated with the WESDR study by Klein et al., 1989[J50] which showed an increase in PDR in individuals with diabetes of 11-15 years duration.

Table – 10 : Visual acuity on presentation

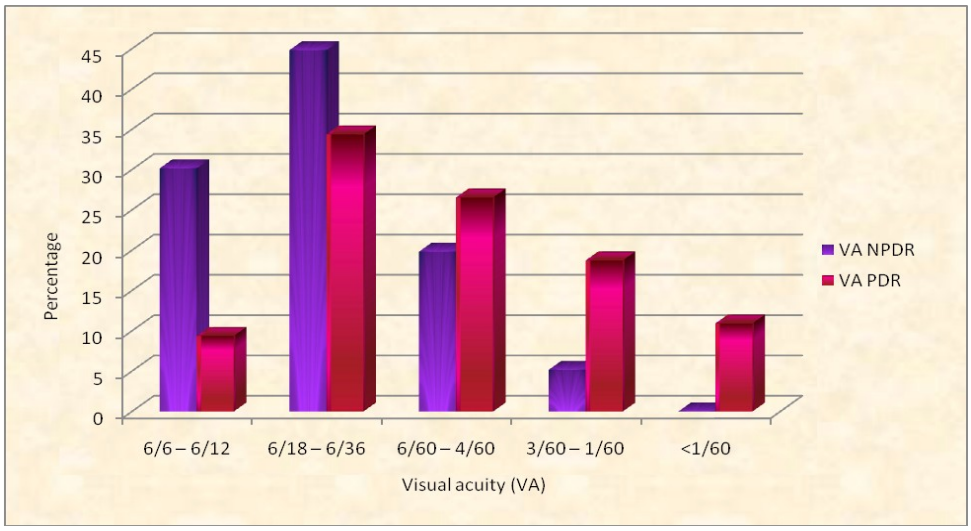
Visual acuity	No. of Eyes	Percentage (%)
6/6 – 6/12	41	22.78
6/18 – 6/36	74	41.11
6/60 – 4/60	40	22.22
3/60 – 1/60	18	10.00
<1/60	7	3.89

On evaluating the visual acuity on the first visit of 90 individuals with retinopathy, 74 (41.11%) had visual acuity between 6/18 – 6/36; 41 (22.78%) had vision > 6/12; 40 (22.22%) had vision between 6/60 – 4/60 and 26 (14.45%) were blind with visual acuity < 3/60.

Table 11 : Visual acuity on presentation and severity of diabetic retinopathy

Visual acuity	No. of Eyes		Percentage (%)	
	NPDR	PDR	NPDR	PDR
6/6 – 6/12	35	6	30.17	9.38
6/18 – 6/36	52	22	44.82	34.38
6/60 – 4/60	23	17	19.83	26.56
3/60 – 1/60	6	12	5.17	18.75
<1/60	-	7	-	10.93

Figure showing the percentage of Visual acuity on presentation and severity of diabetic retinopathy



In NPDR patients, 30.1% had good visual acuity >6/12 on initial presentation. 44.8% had vision between 6/18 to 6/36. Only 5.1% had poor vision <3/60. In PDR patients, 34.38% had vision acuity between 6/18 and 6/36. 36(56.18%) had poor visual acuity of <6/60. The poor visual acuity was due to associated preretinal and vitreous hemorrhage, extensive exudates and further complications.

Table – 12 : Risk Factors

The various risk factors associated with all the 90 individuals with

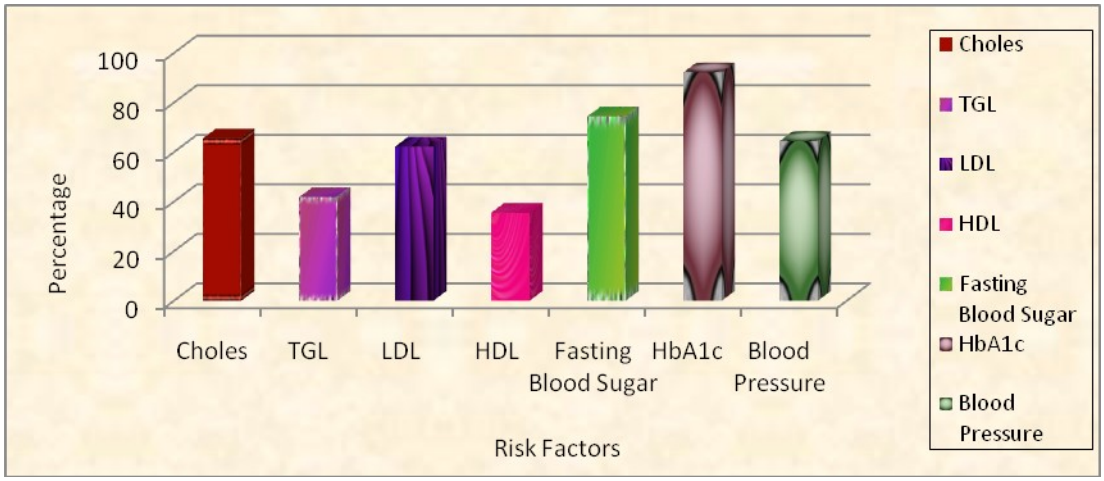
nonproliferative and proliferative diabetic retinopathy are analysed and their levels are given below as mean and standard deviation.

Risk Factors	NPDR Mean±S.D.	PDR Mean±S.D.
Total Cholesterol (mg/dl)	211.2±41.6	258.7±50.2
Triglycerides (mg/dl)	156±27.1	176.9±39.8
LDL (mg/dl)	109.4±27.4	149.2±26.1
HDL (mg/dl)	42±5.3	38.90±5.6
Fasting Blood Sugar (mg/dl)	137.5±26.2	180.5±47.2
HbA_{1c} (%)	8.4±1.2	10.4±1.2
Blood Pressure – Systolic	142.1±16.28	153.4±14.2
Diastolic	87.0±8.9	96.6±10.6
Duration of Diabetes	8.5±5.5	12.78±4.2

The following table shows the number of individuals with abnormal parameters and the range of each parameter in these individuals.

Risk Factors	Range of parameters	Number of individuals	Percentage (%)
Total Cholesterol (mg/dl)	205-353	59	65.5
Triglycerides (mg/dl)	161-268	44	41.8
LDL (mg/dl)	101-191	56	62.2
HDL (mg/dl)	21-39	31	35.5
Fasting Blood Sugar (mg/dl)	127-269	67	74.4
HbA_{1c} (%)	6.1-12.6	83	92.2
Blood Pressure (mmHg) Systolic	140-180	58	64.4
Diastolic	90-110		

Figure showing the percentage of Risk Factors

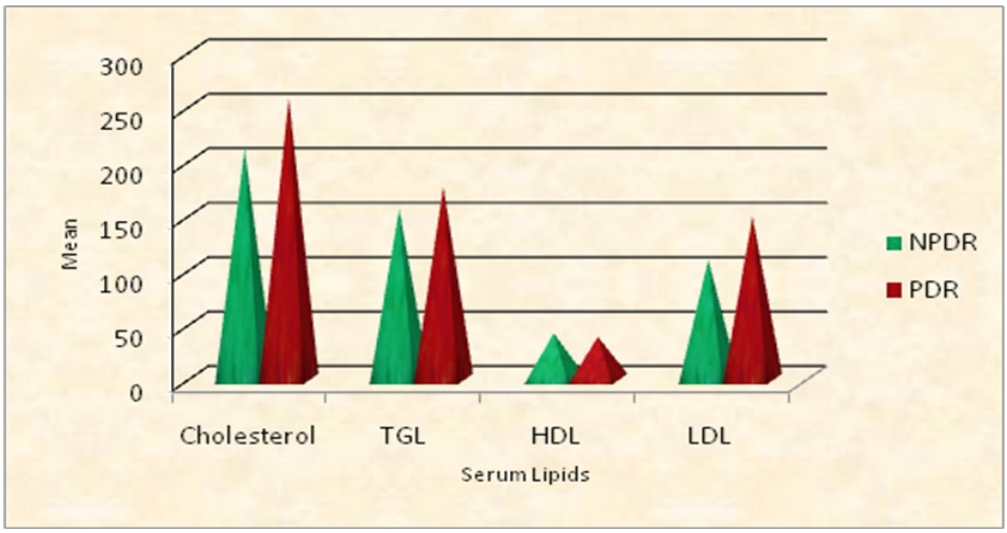


In the total 90 individuals, 59 (65.5%) had hypercholesterolemia and 56 (62.2%) had increased LDL cholesterol levels. In 31 (34.4%) individuals the HDL cholesterol level was less than 40 mg/dl. In more than two thirds of the individuals (92.2%), there was an increased level of glycosylated hemoglobin (HbA_{1c}). An increased fasting blood glucose level was measured in 67 (74.4%) individuals. High blood pressure was noted in 64.4% of individuals.

Table – 13 : Serum Lipids and Diabetic Retinopathy

Retinopathy		**Total Cholesterol**	**TGL**	**HDL**	**LDL**
NPDR	Mean	211.2	156	42	109.4
	S.D	41.6	27.1	5.3	27.4
PDR	Mean	258.7	176.9	38.9	149.2
	S.D	50.2	39.8	5.6	26.1
Z Test	Z_o	4.80	2.85	2.57	6.71
	Z_e	1.96	1.96	1.96	1.96
	p value	0.000	0.005	0.012	0.000

Figure showing the relation of Serum Lipids and Diabetic Retinopathy



Analysis by application of Z test :

Objective : The objective is to test the difference between NPDR and PDR with respect to cholesterol. For that initially we assume a null hypothesis that there is no difference between NPDR and PDR. We applied the Z test.

Inference : Since $Z_o > Z_e$ ($P<0.05$), the null hypothesis is rejected. So there is significant difference between the two groups. Thus, even if both NPDR and PDR have elevated mean cholesterol, its increase was associated more with development of PDR.

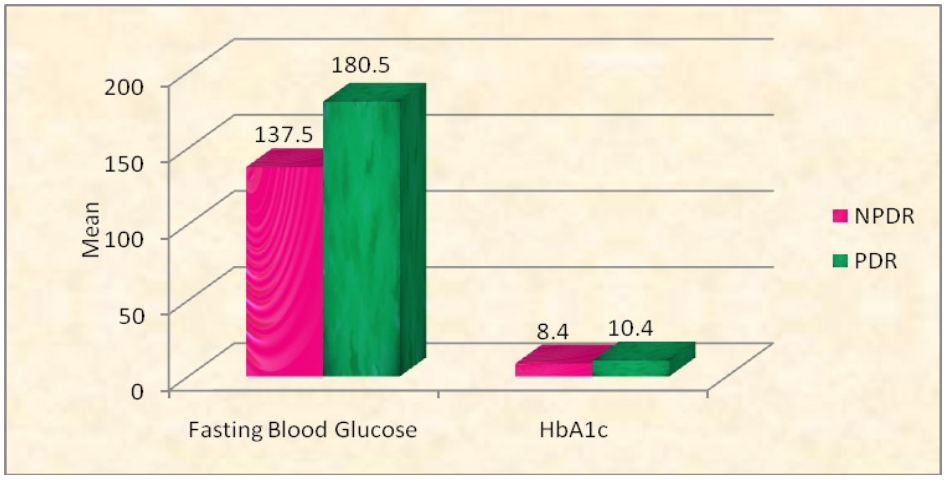
From the above table, we can observe that p value is significant for triglycerides, HDL and LDL also. Thus deranged lipid profile was associated with developing severe forms of retinopathy.

Table – 14 : Fasting Blood Glucose, HbA_{1c} and Diabetic Retinopathy

Retinopathy [58]		**Fasting Blood Glucose**	**HbA_{1c}**
NPDR	Mean	137.5	8.4
	S.D	26.2	47.2

PDR	Mean	180.5	10.4
	S.D	1.2	1.2
Z Test	Z_o	5.57	7.48
	Z_e	1.96	1.96
	p value	0.001	0.002

Figure showing the relation of Fasting Blood Glucose, HbA_{1c} and Diabetic Retinopathy

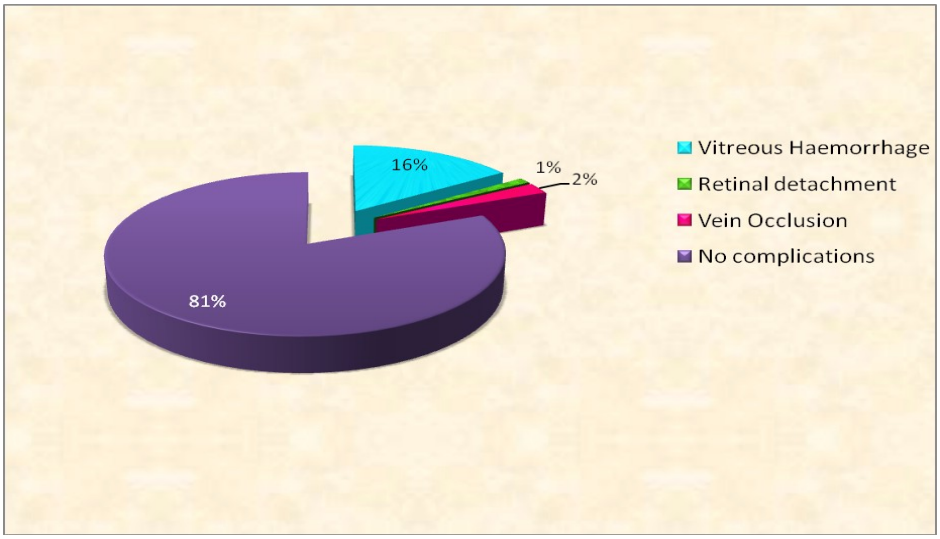


The mean fasting blood glucose levels were 137.5 in NPDR and 180.5 in PDR. Both the groups exhibited an increase level of HbA_{1c} with PDR having a mean of 10.4. By applying Z test, p value (<0.05) was significant for both fasting blood glucose and HbA_{1c}. Thus, individuals with high baseline values present with more severe retinopathy change. This correlated with the study conducted by Agrawal et al., 2003[J43] when HbA_{1c} >10, the level of severe retinopathy was greater

Table – 15 : Ocular Complications

Complications	Number (n=90)	Percentage (%)	Total	
			n	%
With complications				
Vitreous Haemorrhage	14	15.56	17	18.89
Retinal detachment	1	1.1		
Vein Occlusion	2	2.23		
No complications	73	81.11	73	81.11

Figure showing the percentage of Ocular Complications

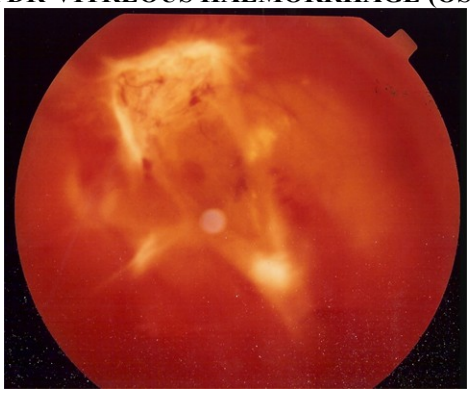


Of the 90 individuals with retinopathy, ocular complications occurred in 17 (18.89%), of which vitreous heamorrhage was the most common occurring in 14 (15.56%). Branch vein occlusion occurred in two individuals. Retinal detachment occurred in one. These individuals had poor visual acuity.

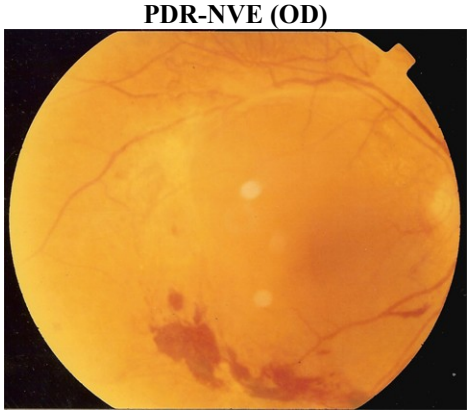
VARIOUS PRESENTATIONS OF PDR IN FOUR PATIENTS

PDR-HRC (OD)

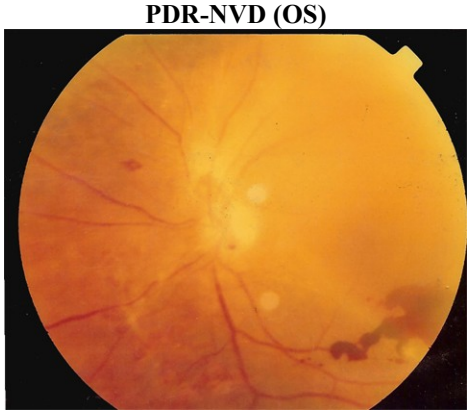
PDR-VITREOUS HAEMORRHAGE (OS)



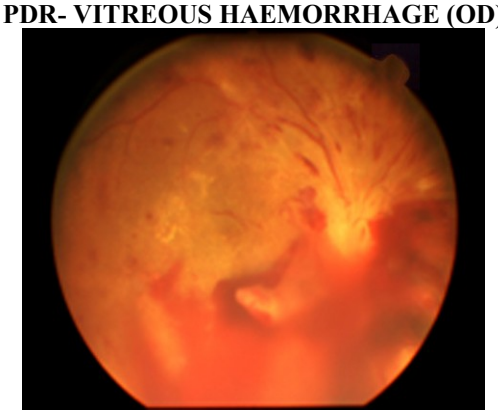
PDR-NVE (OD)



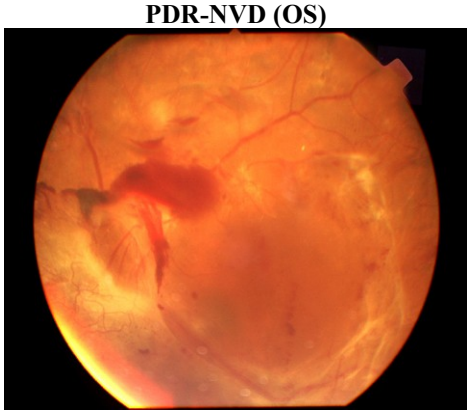
PDR-NVD (OS)



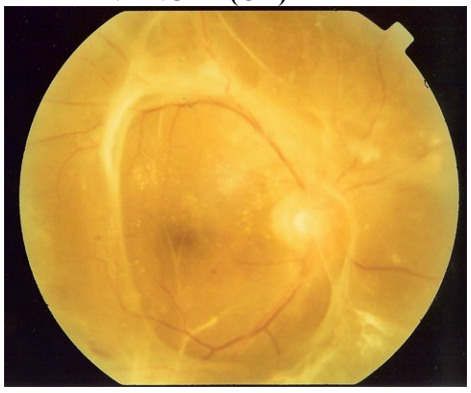
PDR- VITREOUS HAEMORRHAGE (OD)



PDR-NVD (OS)



PDR-ADVANCED (OD)



PDR-NVD (OS)

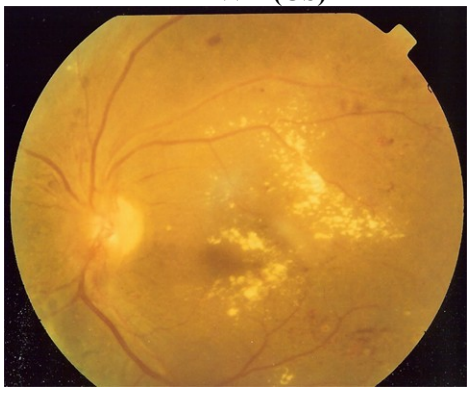
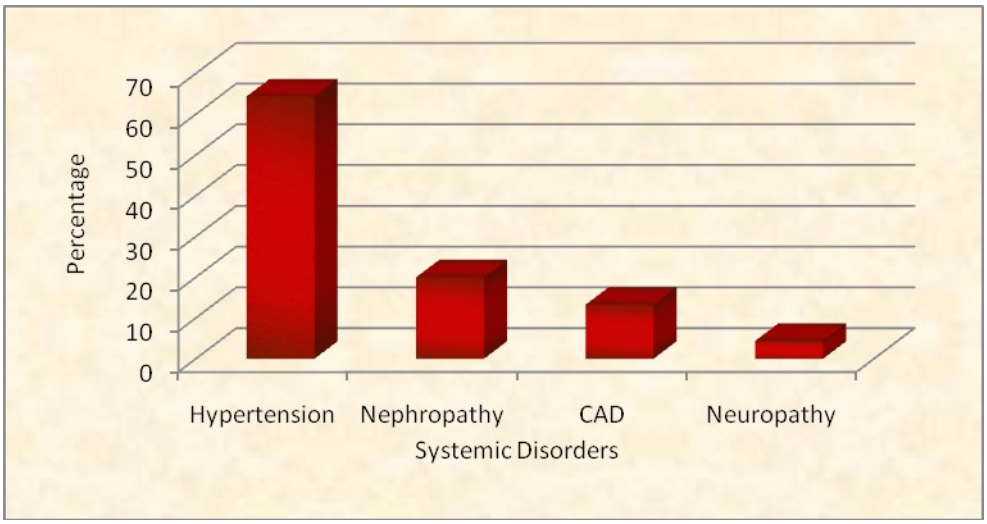


Table – 16 : Systemic Disorders

Systemic Disorders	Number (n=90)	Percentage (%)
Present	59	68.8
Absent	31	31.11

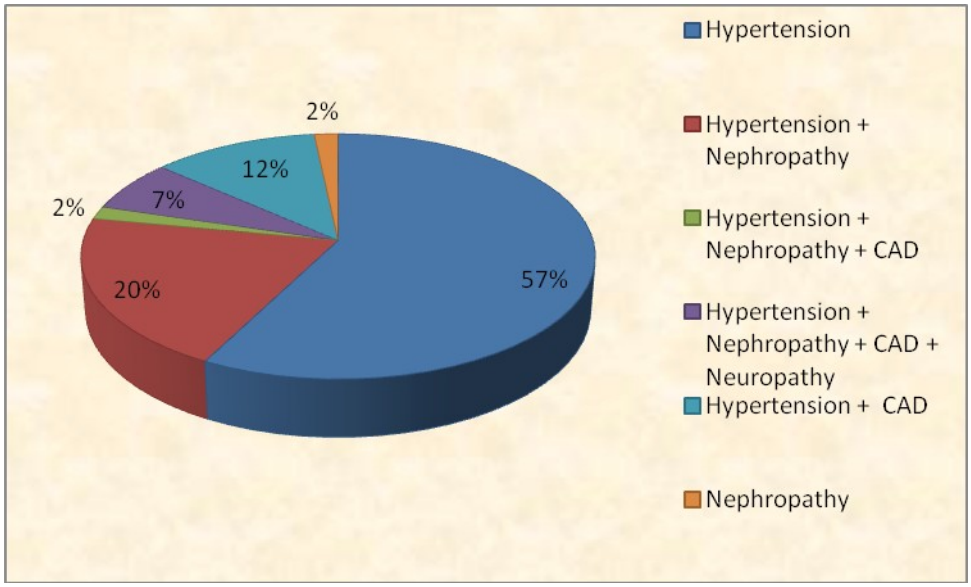
Systemic Disorders	Number (n=90)	Percentage (%)
Hypertension	58	64.4
Diabetic Nephropathy	18	20
Coronary Artery Disease	12	13.3
Peripheral Neuropathy	4	4.4

Figure showing the percentage of Systemic Disorders

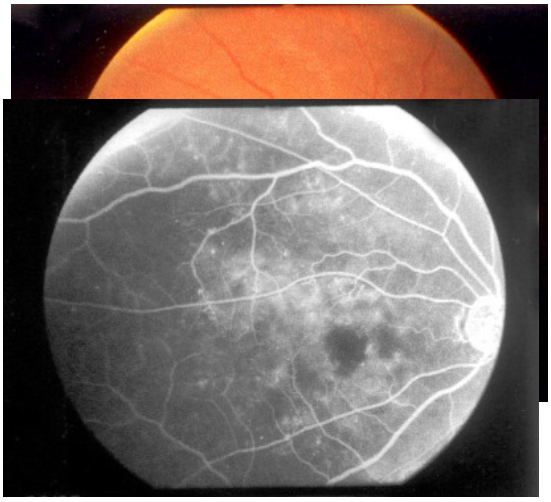


Majority of the individuals 59 (68.89%), had associated systemic disorders including systemic hypertension, diabetic nephropathy, coronary artery disease and peripheral neuropathy. 58 individuals had associated systemic hypertension, 18 (30.5%) of them had nephropathy, 12 (20%) had coronary artery disease, 4 (6.8%) had peripheral neuropathy.

The following picture depicts the various combinations of systemic disorders associated with the study group.

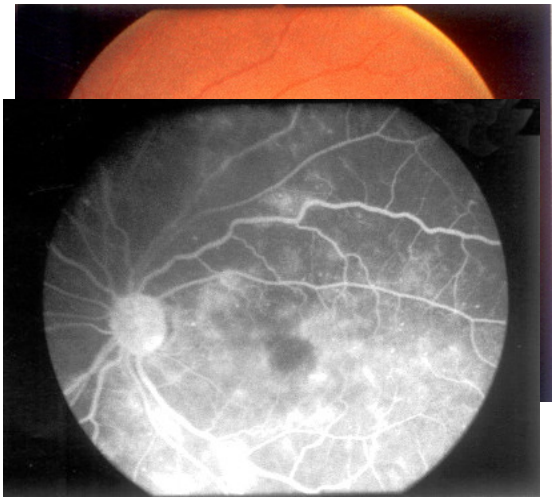


FUNDUS PHOTOGRAPH (OD)



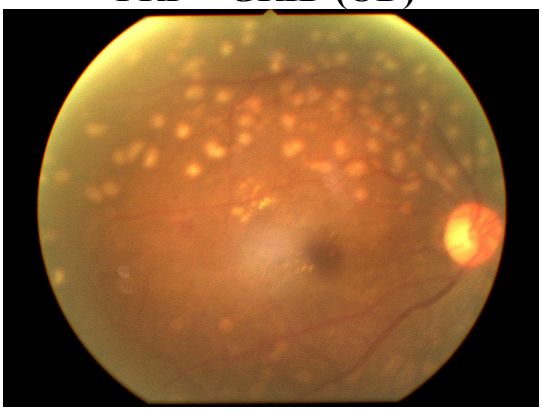
FLUORESCEIN

FUNDUS PHOTOGRAPH (OS)



ANGIOGRAPHY

PRP + GRID (OD)



PRP + GRID (OS)

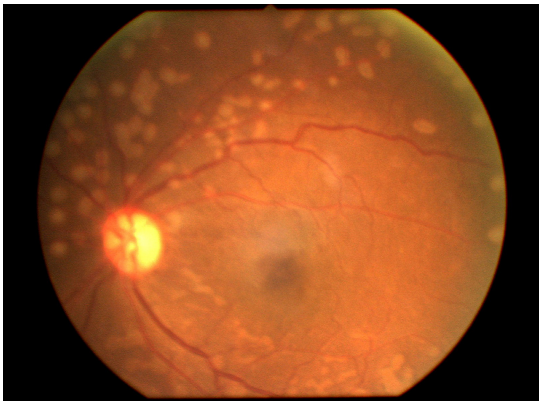
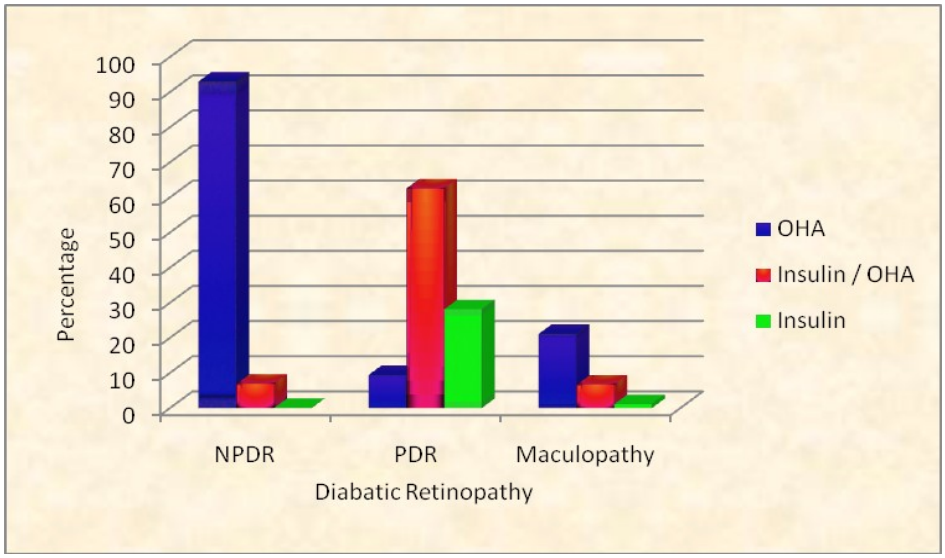


Table – 17 : Diabetic Retinopathy and treatment of Diabetes mellitus

Treatment of diabetes mellitus	NPDR		PDR		Maculopathy	
	n	%	n	%	n	%
OHA	54	93	3	9.4	19	21.1
Insulin	-	-	9	28.1	1	1.1
Insulin / OHA	4	6.9	20	62.5	6	6.67

Figure showing the relationship of diabetic retinopathy and treatment of diabetes mellitus

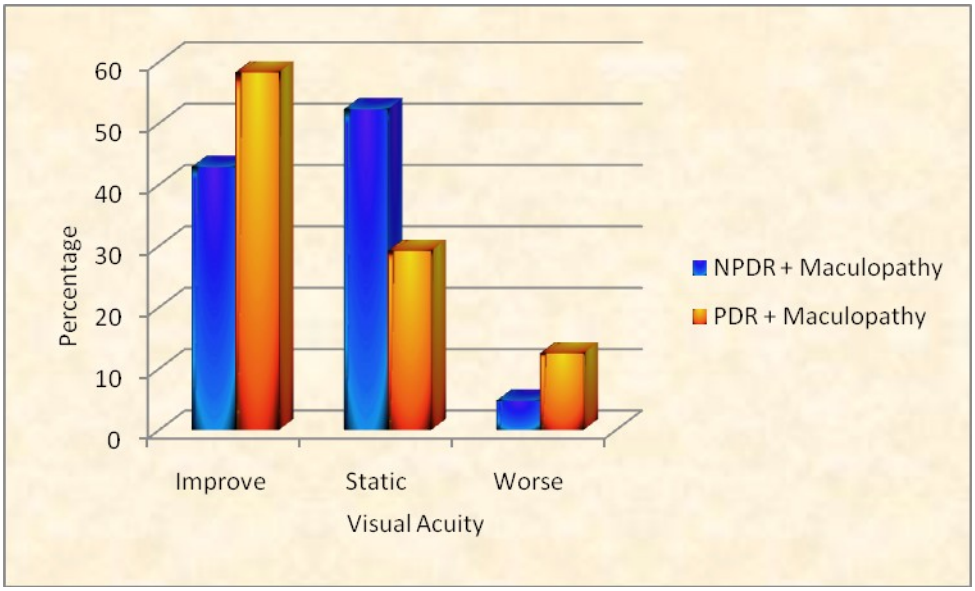


In the study, out of the 58 subjects with NPDR, 54 (93.1%) were on oral hypoglycemic agents and 4 (6.9%) were on both insulin and OHA. No NPDR was on insulin alone. Among 32 individuals of PDR, 20 (62.5%) were on both insulin and OHA, 9 (28.1%) were on only insulin and three individuals were only on OHA. The study by Bodansky et al 1982[J44], showed that most cases of PDR occurred in insulin taking individuals. Out of the 26 individuals with maculopathy, 19 (21.1%) were on OHA, remaining 7 individuals were either on insulin alone or on both insulin and OHA.

Table – 18 : Laser in Diabetic Retinopathy and visual acuity

Visual acuity	Total	Visual Improvement		Static		Worse	
		n	%	n	%	n	%
NPDR ± Maculopathy	21	9	42.9	11	52.3	1	4.8
PDR ± Maculopathy	24	14	58.3	7	29.2	3	12.5

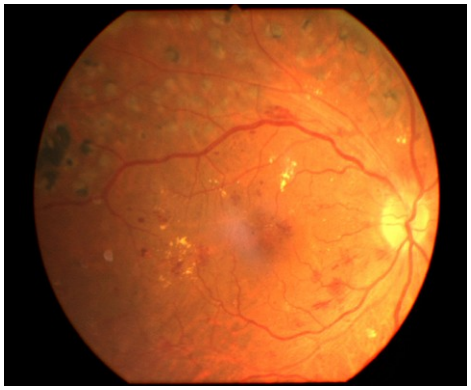
Figure showing the relationship of Laser in Diabetic Retinopathy and visual acuity



Among 21 NPDR individuals, 6 received grid, 7 had focal, 1 had PRP and 7were given both PRP and grid photocoagulation. Visual improvement occurred in 9 (42.9%). In 11 (52.3%) individuals, the vision was stationary. One patient (4.8%) had a failing visual acuity. In 24 PDR individuals visual improvement occurred in 14 (58.3%), 7 (29.2%) had the same vision and in 3 (12.5%) the vision worsened. Individuals with maculopathy improved more with laser.

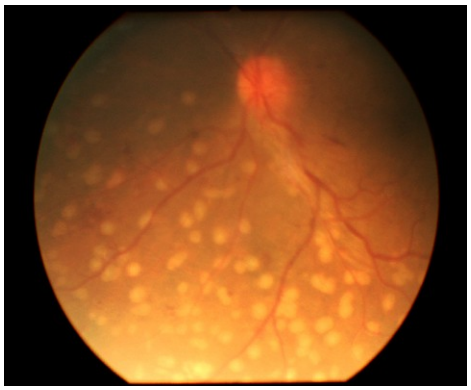
PDR – PRE LASER

PDR – POST LASER

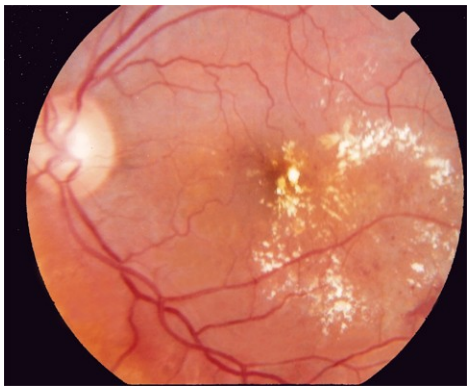


PDR – PRE LASER

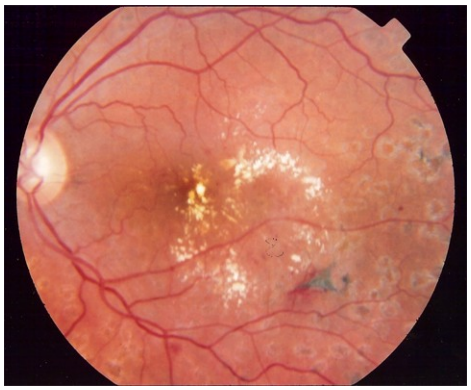
PDR – POST LASER



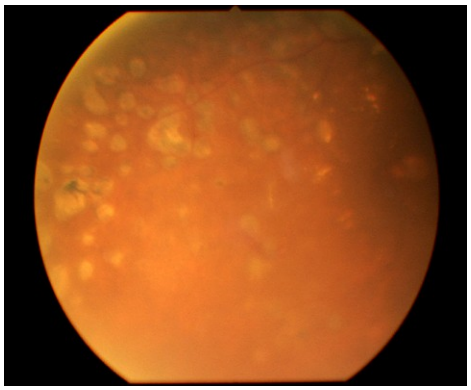
MACULOPATHY – PRE LASER



MACULOPATHY – POST LASER



PDR – POST LASER



POST LASER HAEMORRHAGE

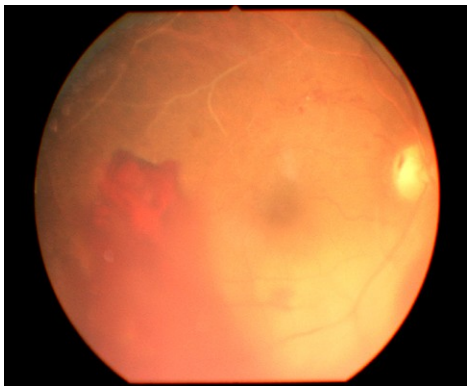
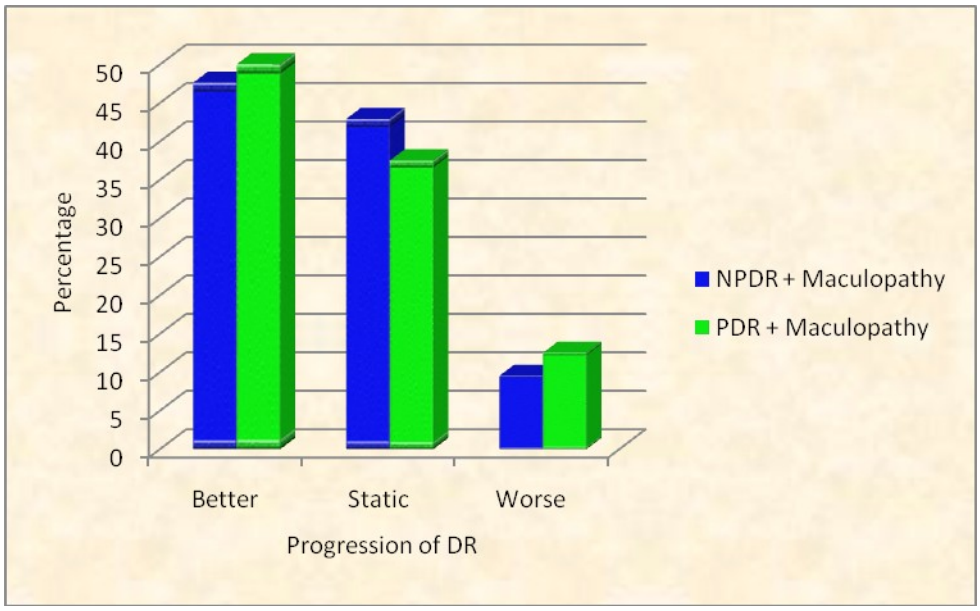


Table – 19 : Laser and progression of retinopathy

Control on Progression	Total	Better		Static		Worse	
		n	%	n	%	n	%
NPDR ± Maculopathy	21	10	47.6	9	42.9	2	9.5
PDR ± Maculopathy	24	12	50	9	37.5	3	12.5

Figure showing the relationship of Laser and progression of retinopathy



Among the NPDR individuals 47.6% had a good control, in 42.9% the retinopathy was static and it progressed to severe degrees of retinopathy in two individuals (9.5%). Whereas in PDR 50% had very good control over progression. In three individuals (12.5%) fresh neovascularisation occurred. Application of laser showed good improvement in the status of retinopathy in PDR individuals.

Discussion

DISCUSSION

The diabetics attending the Eye department, Coimbatore Medical College Hospital, from January 2006 to October 2007 are enrolled and studied for the pattern of presentation of diabetic retinopathy. 270 diabetics attended the OPD of whom 90 diabetics had diabetic retinopathy were studied.

- **The predominant age group** affected with diabetic retinopathy was 51-60 years. Retinopathy rates were higher (46.67%) in 51-60 years and 23.3% of retinopathy occurred in 61-70 years age group. In a study conducted by Khandekar et al., 2003[J41], retinopathy rate was commonly documented in 50-59 years and 60-69 years. This is confirmed in another study done by Dandona et al., 1999[J42], Agrawal et al., 2003[J43] and Wisconsin epidemiologic study on diabetic retinopathy by Klein et al., 1984 [J2J3].
- **The gender** wise distribution showed a preponderance for male sex. The ratio being 1.6 : 1 most of the male sex was associated with severe forms of retinopathy. This correlated with the study by Bodansky et al., 1982 [J44] which showed the ratio as 2:1 and Rema et al., 2005[J45]. A similar male predominance has been reported by Dandone et al 1999[J42] and Kohner et al 1998[J46].
- In our study, 45.5 % of the individuals had **family history of diabetes.** 39% of NPDR and 60% of PDR had a positive family history. In the above group, there was a higher risk of proliferative retinopathy. This correlated with studies

conducted by Mohan et al 1986[J47] and Ramchandran et al 1992[J48].

- **Magnitude of retinopathy**

Out of 270 diabetic individuals 90 (33.33%) had retinopathy. This comprised of 58 (64.44%) individuals of NPDR and 32 (36.56%) of PDR. NPDR was the most common retinopathy seen. This correlated with the studies conducted by Agrawal et al 2003 [J43] and Narendran et al 2002 [J49].

In our study, among the 32 PDR individuals, most (21) were with high risk characteristics. Among 90 retinopathy individuals, 26 (9.63%) had maculopathy. This can be compared with a hospital based study done by Khandekar et al 2003[J41] Maculopathy was associated more commonly with NPDR individuals (73.08%) than with PDR (2.59%).

- **Duration of diabetes** 67

When duration of diabetes was less than 5 years, only 20 individuals (22.2%) had retinopathy. With duration >10 years, 45.44% had retinopathy of varying severity.

In this study individuals with less than 5 years of diabetes, 18 (20%) had NPDR and only 2 (2.2%) had PDR. At 6-10 years period NPDR was more, accounting for 33.3% and as the duration of the diabetes progressed, PDR was

on the rise reaching a peak of 16.7% in 11-15 years. Most of the mild NPDR had less than 5 years of diabetes and moderate NPDR had 6-10 years of diabetes. After 15 years of diabetes PDR was more than NPDR (6.7% vs 3.3%). This correlated with the WESDR by Klein et al 1989[J50] which showed an increase in PDR when diabetes is around 15 years.

Thus individuals with long standing diabetes, there is an increased risk and severity of retinopathy and maculopathy which correlated with the study conducted by Eckhard Zander et al 2000 [J51].

- **Visual acuity :** On first visit most individuals (74, 41.1%) had visual acuity between 6/18-6/36 and 14.44% had less than 3/60. In NPDR 30% had presenting visual acuity >61/12 whereas, in PDR, only 9.3% had vision >6/12. In the later group 56.2% had visual acuity <6/60. This depicts the intense impact of the severity of retinopathy on visual acuity.

- **Lipids :** In our study the mean baseline total cholesterol, LDL, TGL and HDL levels in NPDR were 211.29 mg/dl ,109 mg/dl, 156 mg/dl, 4.2 mg/dl and that in PDR were 258.6 mg/dl, 149.25, 176.8 mg/dl and 38.9 mg/dl respectively.

Cholesterol and LDL were higher in both NPDR and PDR. HDL was lower in PDR. This correlated with Dornan et al., 1982[J52] which showed association of PDR with raised cholesterol and LDL. Klein et al 1988 and Chew et al 1996 [J6] showed a significant trend for increased severity of retinopathy with an increase in cholesterol.

- **Hyperglycemia :** In diabetics with NPDR, the mean baseline fasting blood glucose, HbA_{1c} were 137.5 mg/dl, 8.4% and that of PDR were 149.25 mg/dl, 10.4% respectively.

  Hyperglycemia was an associated factor in both the groups. Klein et al 1984 [J2,3] and DCCT study (1993) showed the similar findings. Agrawal et al 2003[J43] stated that if HbA_{1c} > 10, prevalence of severe retinopathy was more. In the WESDR, if baseline HbA_{1c} was between 10.1– 11.5%, PDR was more.

  Date from the WESDR showed that HbA_{1c} was associated with the incidence and progression of retinopathy, progression to PDR and incidence CSME (Klein et al., 1988, 1994 [J53,54]).

- The mean systolic and diastolic **BP** in NPDR were 142.06±2.21 and 81.03±1.16 respectively. The mean systolic and diastolic BP in PDR were 15.4±2.5 and 96.6±1.8 mmHg respectively. In both the groups the systolic BP was raised whereas PDR was associated with an increase in diastolic BP also.

  Thus, PDR was associated hypercholesterolemia increased LDL, increase mean baseline fasting blood glucose & HbA_{1c} and high diastolic BP which correlated with Ossama et al 1998 [J56] and UKPDS[J7].

- Of the 90 individuals, 15.5% had vitreous haemorrhage, one individual (1.1%) had RD and two had BRVO.

- In our study, we had 59 (68.8%) with systemic disorders. Hypertension was present alone in 34 (57.6%) and in conjunction with nephropathy in 12 (20.3%)

and CAD in 7 (11.8%). All the 4 (6.8%) individuals had all the four disorders, out of which 2 were on insulin. This correlated with the study conducted by Tasanee et al 2007[J57] which showed 61.8% with hypertension.

- Of the 33 individuals on insulin, 29 had PDR and 4 (4.4%) had NPDR. Treatment with insulin is associated with more severe progressive retinopathy (Agrawal et al 2003 [J43]).
- A total of 45 individuals with PDR and NPDR, maculopathy were subjected to laser photocoagulation. Of them, 23 (51.1%) had improvement in the visual acuity and 22 (4.88) had stable visual acuity.

22 had good control over progression of retinopathy, 18 showed no further progression and only 5 showed progressive changes. This effectiveness on laser in improving visual acuity and checking the progression of retinopathy by ETDRS[J21] and DRS [J29 J37].

Summary

SUMMARY

- Diabetic retinopathy more commonly presented in 51-60 years and a significant number occurred in the next decade (61-70 years).
- Males were commonly affected with diabetic retinopathy than females.
- Most of the individuals with the PDR had a positive family history of diabetes. There is an increased risk of proliferative changes in individuals with a positive history.
- Of all the diabetics reported 33% had diabetic retinopathy. NPDR occurred in majority of the diabetes. In PDR group, high risk characteristics occurred more. Maculopathy occurred in 9.63%.
- On comparing the duration of diabetes, in the study group, PDR was reported in more than 23.4% as the duration of diabetes increased to more than 10 years. Duration of diabetes is strongly associated with the incidence and progression of retinopathy. Increased duration of diabetes had an increased risk of retinopathy.
- Majority of the NPDR (42.82%) had a presenting visual acuity greater than 6/36. The low vision in NPDR is associated with maculopathy. In PDR 34.38% had vision between 6/18 to 6/36 and 56.2% had poor visual acuity of <6/60. This shows that proliferative changes are associated with deteriorating visual acuity.
- Hypercholesterolemia, elevated LDL, TGL and reduced HDL levels were associated with PDR. Elevated cholesterol and LDL levels were associated with

NPDR. Diabetics with deranged lipid profile were more prone for severe diabetic retinopathy, and increased incidence of maculopathy.

- Hyperglycemia manifested as elevated mean baseline fasting blood glucose and HbA_{1c} is a significant risk factor in the development and progression of retinopathy. High blood pressure is strongly associated with retinopathy.
- Vitreous haemorrhage was the most common ocular complication. hypertension, nephropathy and CAD were commonly associated systemic disorders.
- 90% of Proliferative Diabetic Retinopathy were on insulin.
- Laser photocoagulation improved visual acuity in 51.1% and kept the progression of retinopathy under control in nearly half of the individuals.

Conclusion

CONCLUSION

- Diabetic retinopathy is more common after 50 years of age.
- There is a preponderance of males for diabetic retinopathy.
- Individuals having positive family of diabetes have progressive and severe retinopathy changes.
- 33% of individuals had retinopathy and among them NPDR is the most common form of retinopathy.
- Increased duration of diabetes is associated with increased risk of developing retinopathy.
- Abnormal level of lipids, abnormal fasting blood glucose and HbA_{1c} and elevated blood pressure are important risk factors of diabetic retinopathy.
- Diabetic retinopathy causes a morbid decrease in vision.
- Common complication associated is vitreous haemorrhage and common systemic disorder associated is systemic hypertension followed by nephropathy.
- Periodic ocular examination in all diabetics should be carried out.
- Early diagnosis of maculopathy and its early treatment with laser reduces significant

visual loss.

- Diabetic retinopathy is a preventable cause of blindness especially in developing countries. Timely intervention with laser treatment saves the individual from severe visual loss by controlling the progression of retinopathy.

Bibliography

BIBLIOGRAPHY

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Appendix

PROFORMA

Name :

Age :

Sex :

Hospital no :

Address :

Telephone no :

Complaints :

Defective vision : RE/LE/Both

Duration :

Onset : gradual/sudden

Any other complaints :

Past history

h/o similar episodes :

nature of treatment :

h/o diabetes :

age of onset :

duration :

nature of treatment :

h/o hypertension :

duration :

h/o heart disease :

duration :

h/o systemic disorders :

Ocular examination		**RE**	**LE**
Visual acuity	:		
IOP	:		
Lids	:		
Conjunctiva	:		
Cornea	:		
AC	:		
Pupil	:		
Lens	:		
Retinoscopy	:		
Subjective	:		
BCVA	:		

Fundus examination :

Direct - media :

Disc :

Vessels :

Macula :

Retina :

Indirect- media :

Disc :

Vessels :

Macula :

Peripheral retina :

S/L with +78 D :

Fundus Fluorescein Angiography :

Diagnosis :

Investigations

Blood pressure :

Fasting blood glucose :

HbAIC :

Cholesterol :

TGL :

HDL :

LDL :

Blood urea :

Serum creatinine :

ECG :

Urine-albumin :

Sugar :

Deposits :

Photocoagulation

PRP :

Focal :

Grid :

Follow-up

Fundus :

Slit Lamp :

ABBREVIATIONS

M	-	Male
F	-	Female
Dur	-	Duration in years
VA	-	Visual Acuity
BCVA	-	Best corrected visual acuity
RE	-	Right eye
LE	-	Left eye
BP	-	Blood pressure
Chol	-	Cholesterol
TGL	-	Triglycerides
HDL	-	High density lipoproteins
LDL	-	Low density lipoproteins
SrCr	-	Serum Creatinine
FBG	-	Fasting Blood Glucse
HbA1C	-	Glycosylated Hemoglobin
SHT	-	Systemic hypertension
DN	-	Diabetic Nephropathy
CAD	-	Coronary Artery Disease
PN	-	Peripheral Neuropathy
Mild NPDR	-	Mild nonproliferative diabetic retinopathy

Mod NPDR	-	Moderate nonproliferative diabetic retinopathy
Sev NPDR	-	Severe nonproliferative diabetic retinopathy
V S NPDR	-	Very Severe nonproliferative diabetic retinopathy
NH PDR	-	Non High risk Proliferative diabetic retinopathy
HR PDR	-	High risk Proliferative diabetic retinopathy
COM	-	Complications
FFA	-	Fundus Fluorescein Angiography
CD	-	Capillary Dropouts
DL	-	Diffuse Leaks
BF	-	Blocked Fluorescence
FL	-	Focal Leaks
LNV	-	Leaking New Vessels
NV	-	No View
ISCH	-	Ischaemia
PRP	-	Pan retinal photocoagulation
G	-	Grid
F	-	Focal
I	-	Insulin
O	-	Oral
I/O	-	Insulin / Oral

Sl. No.	Name	Age	Sex	Dur	VA		BCVA		Family H/O	BP	Lipid Profile (mg/dl)				Blood Urea (mg/dl)	Sr Cr (mg/dl)	FBG (mg/dl)	HbA1c (%)	Sy
					RE	LE	RE	LE			Chol	TGL	HDL	LDL					SHT
1	Subramani	32	M	10	6/36	6/60	6/18	6/60	+	130/80	275	157	41	166	30	0.9	183	11	-
2	Rajendran	51	M	15	6/24	5/60	6/24	5/60	-	160/100	239	95	36	187	35	1.0	250	11.5	+
3	Syed Mohammed	51	M	7	6/9	6/6	6/9	6/6	-	140/90	146	163	42	93	28	0.8	179	9	+
4	Dakshinamorthy	44	M	12	HM	6/60	HM	6/60	+	130/80	306	187	35	141	24	0.8	239	12	-
5	Chellappan	50	M	9	6/60	6/60	6/60	6/60	+	150/90	295	148	30	156	63	4.6	206	11	+
6	Sakkariya	67	M	25	6/36	6/60	6/24	6/60	+	160/96	198	153	40	96	33	1.0	197	10	+
7	Maruthachalam	55	M	13	6/36	HM	6/18	HM	+	130/80	189	165	44	129	56	3.8	193	10	-
8	Ravi	42	M	3	6/60	5/60	6/60	5/60	+	160/100	216	162	40	137	28	0.5	256	8.6	+
9	Jothi	58	F	1	6/12	6/36	6/6	6/9	-	140/90	183	146	48	86	30	1.0	110	5.7	+
10	Chandrasekar	54	M	13	6/36	6/36	6/36	6/36	-	160/90	210	163	45	171	28	0.8	130	9	+
11	krishnasamy	53	M	5	6/36	6/24	6/24	6/18	+	150/100	198	138	46	105	24	0.9	172	7.7	+
12	Palaniammal	49	F	15	5/60	3/60	5/60	3/60	+	160/90	230	168	35	71	30	1.0	169	9	+
13	Moideen kutti	65	M	9	6/24	6/60	6/24	6/36	-	150/90	187	113	43	84	28	0.8	123	8	-
14	Palaniammal	62	F	8	1/60	6/12p	1/60	6/12	+	150/100	272	163	35	163	30	0.6	115	11.2	+
15	Aleema	52	F	6	6/12	6/12	6/12	6/9	-	140/90	220	158	39	96	24	1.0	98	10.1	+
16	Parvathy	55	F	5	6/60	6/60	6/60	6/60	-	140/90	190	151	44	98	32	0.7	136	9.4	+
17	Jayaprakash	45	M	7	6/18	6/24	6/9	6/12	-	130/80	275	205	42	127	28	1.2	147	5.9	-
18	SivaKumar	42	M	11	3/60	1/60	3/60	1/60	+	180/100	298	268	47	137	27	0.9	269	10.9	+
19	Maria matilda	62	F	12	CFCF	6/60	CFCF	6/24	+	150/100	277	217	43	117	30	0.8	175	12	+
20	ArunachalGoundar	60	M	15	4/60	3/60	6/36	3/60	-	160/110	217	220	21	128	34	0.6	152	9.8	+
21	Rajabunisha	48	F	7	6/24	1/60	6/12	1/60	+	150/100	297	191	30	91	26	0.7	141	11.7	+
22	Rukmani	55	F	13	2/60	6/36	2/60	6/36	-	130/84	230	185	41	76	28	0.8	130	9	-
23	Sampoornam	58	F	8	6/60	1/60	6/36	1/60	+	140/80	189	190	40	167	24	1.0	125	9	-
24	Palaniappan	50	M	2	6/36	6/36	6/36	6/36	-	150/90	229	189	34	98	30	0.9	136	9.6	+
25	Mariammal	55	F	1.5	6/24	6/9P	6/9	6/9	-	126/78	183	134	48	115	26	0.8	111	7.5	-

Sl. No.	Name	Age	Sex	Dur	VA		BCVA		Family H/O	BP	Lipid Profile (mg/dl)				Blood Urea (mg/dl)	Sr Cr (mg/dl)	FBG (mg/dl)	HbA1c (%)	Sy
					RE	LE	RE	LE			Chol	TGL	HDL	LDL					SHT
26	Nagammal	54	F	9	6/60	6/60	6/24	6/18	-	158/90	282	153	44	97	32	1.0	102	9	+
27	Basha	52	M	13	6/60	6/36	6/36	6/24	+	140/80	193	186	42	135	28	0.9	151	8.6	-
28	Bagiam	58	F	8	6/36	6/24	6/36	6/24	-	142/100	148	164	40	164	24	1.2	130	7.5	+
29	Padmavathy	46	F	8	6/36	5/60	6/24	5/60	-	140/90	214	157	50	112	28	0.8	141	8	+
30	Subramani	33	M	15	5/60	6/36	5/60	6/36	+	150/100	264	138	48	144	52	3.6	168	12.2	+
31	Muruganantham	55	M	17	1/60	6/9	1/60	6/9	-	160/100	270	187	33	173	48	2.6	174	9.8	+
32	Anthonysamy	63	F	12	6/60	4/60	6/60	4/60	+	180/100	236	199	43	94	32	1.0	116	8	+
33	Jilthre	61	F	10	6/36	6/60	6/24	6/60	-	162/90	269	186	35	82	28	0.8	135	9.9	+
34	Dhandapani	63	M	20	6/60	6/60	6/36	6/36	+	170/110	230	156	49	128	53	3.6	188	11.7	+
35	Kameshwari	42	F	3	6/9	6/18	6/9	6/12	-	110/80	142	120	45	77	26	0.9	140	7.1	-
36	John	63	M	20	6/60	3/60	6/60	3/60	+	180/100	284	156	43	142	28	1.0	228	12	+
37	Ponnuraj	48	M	2	6/24	612	6/12	6/12	-	130/80	166	140	36	104	32	0.9	145	7	-
38	Devasagayam	55	M	15	6/18	6/18	6/18	6/18	+	140/100	147	139	35	148	26	0.8	151	9.2	+
39	Chandrasekar	58	M	9	2/60	5/60	2/60	5/60	-	130/86	212	180	43	98	30	0.9	136	8	-
40	Pushpam	57	F	7	6/36	HM	6/36	HM	-	160/90	278	150	47	136	28	1.2	207	9.4	+
41	Vishwanathan	53	M	12	1/60	6/12	1/60	6/9	+	150/100	264	184	40	191	29	0.8	246	10.7	+
42	Saraswathi	62	F	5	6/24	6/9	6/9	6/6	-	110/70	205	148	50	79	34	1.2	151	5.5	-
43	Celine	65	F	6	6/36	6/9	6/36	6/9	-	150/80	178	152	42	87	26	0.8	143	7.9	-
44	Selvaraj	49	M	10	3/60	5/60	3/60	5/60	+	156/100	256	181	32	169	68	4.3	127	10	+
45	Pushpa	50	F	9	6/9	6/18	6/9	6/12	-	140/90	184	105	47	107	30	0.9	124	7.3	+
46	Paulraj	68	M	1.5	5/60	6/24	6/60	6/60	-	150/100	215	240	38	131	48	2.7	186	11	+
47	Gnanavelu	61	M	6	6/24	6/18	6/24	6/12	+	140/90	196	173	44	91	43	1.9	162	10.2	+
48	Arumugam	75	M	11	6/36	5/60	6/36	6/60	-	150/90	147	163	43	76	46	2.8	77	9.0	+
49	Selvambal	58	F	2	6/24	6/24	6/18	6/18	+	172/90	218	140	42	81	28	0.8	95	7.3	+
50	Brahmagiri	53	M	15	6/36	6/18	6/18	6/12	+	150/100	158	125	48	87	26	0.8	130	10.1	+

Sl. No.	Name	Age	Sex	Dur	VA		BCVA		Family H/O	BP	Lipid Profile (mg/dl)				Blood Urea (mg/dl)	Sr Cr (mg/dl)	FBG (mg/dl)	HbA1c (%)	Sys
					RE	LE	RE	LE			Chol	TGL	HDL	LDL					SHT
51	Ponnusamy	44	M	7	6/36	6/24	6/36	6/24	-	120/80	286	160	36	95	28	0.9	146	7	-
52	Muthusamy	55	M	14	6/60	6/24	6/60	6/24	-	140/80	216	158	40	127	58	3.6	141	7	+
53	Venkatachalam	74	M	12	6/36	6/60	6/36	6/60	-	170/100	233	173	32	154	30	1.0	175	8.6	+
54	Mani	60	M	11	5/60	6/60	6/36	6/60	+	180/100	281	159	38	187	28	0.8	186	10.6	+
55	Panikar	55	M	6.5	6/24	6/18	6/24	6/18	+	140/70	190	141	40	110	26	0.9	141	7.4	-
56	Kaliammal	55	F	20	6/60	6/24	4/60	4/60	+	160/90	287	145	38	96	24	1.0	25	9	+
57	Murugan	44	M	9	6/36	6/60	6/36	6/60	+	140/86	252	196	38	135	36	0.8	132	11.2	-
58	Padmavathy	46	F	7	6/6	6/36	6/6	6/24	-	154/90	234	127	50	108	28	0.9	120	7.2	+
59	Mohammed Kasim	52	M	5	6/9	6/9	6/9	6/9	-	140/100	117	132	48	96	46	2.8	93	6.9	+
60	Abdul Khadar	61	M	1	6/60	5/60	6/60	5/60	-	150/90	288	199	32	124	30	1.0	149	7	+
61	Narayanasamy	53	M	10	3/60	6/24	3/60	6/18	+	152/100	267	158	34	116	30	0.8	167	10.1	+
62	Basheer Ahamed	56	M	20	6/18	6/60	6/18	6/36	+	180/100	294	158	30	123	62	4.3	183	8.7	+
63	Shanthi	45	F	14	1/2/60	6/24	1/2/60	6/24	+	160/110	353	170	40	149	28	1.0	98	11	+
64	Rathi	58	F	5	6/36	6/9	6/12	6/9	-	126/17	196	143	51	96	30	0.9	121	7	-
65	Natarajan	47	M	8	6/18	6/12	6/18	6/12	-	130/80	178	158	46	183	28	0.9	147	7.5	-
66	Chandra	69	F	17	HM	6/12	HM	6/12	+	170/100	273	182	39	141	26	0.8	219	10	+
67	Ameer Basha	60	M	14	6/24	6/24	6/24	6/24	-	160/110	336	215	35	168	47	3.5	196	10.3	+
68	Dhakshnamoorthy	44	M	9	1/60	6/60	1/60	6/36	+	140/86	248	193	41	91	28	0.8	174	9.6	-
69	Arokiamoorthy	54	M	12	6/36	6/18	6/36	6/12	-	130/86	261	168	43	162	30	0.9	153	9.7	-
70	Subramanian	65	M	11	6/60	6/60	6/12	6/60	-	150/90	259	158	40	112	28	0.8	138	9	+
71	Sivasubramaniam	57	M	13	6/60	6/60	6/24	6/60	-	140/80	196	141	47	118	28	0.9	120	7.6	-
72	Karthikeyan	56	M	11	3/60	2/60	3/60	2/60	-	160/110	318	162	35	172	48	3.3	116	11.5	+
73	Divakaran	76	M	7	6/60	6/18	6/18	6/18	+	130/76	213	153	41	87	26	0.8	132	9	-
74	Subbulakshmi	70	F	5	6/36	6/24	6/36	6/24	-	140/90	146	98	42	91	30	1.2	99	7	+
75	Nagammal	62	F	20	6/36	4/60	6/36	1/60	-	120/80	298	170	40	168	28	0.8	164	9.2	-

Sl. No.	Name	Age	Sex	Dur	VA		BCVA		Family H/O	BP	Lipid Profile (mg/dl)				Blood Urea (mg/dl)	Sr Cr (mg/dl)	FBG (mg/dl)	HbA1c (%)	Sy
					RE	LE	RE	LE			Chol	TGL	HDL	LDL					SHT
76	Eswaramoorthy	59	M	12	6/60	6/36	6/24	6/36	+	140/90	276	151	49	155	28	0.9	158	12	+
77	Parvathy	58	F	15	1/60	1/60	1/60	1/60	+	150/100	178	252	39	183	26	1.0	159	8.2	+
78	Anthony	65	M	7	6/18	6/24	6/18	6/18	-	140/84	217	153	41	88	30	0.8	150	10.2	-
79	Ganesh	44	M	1	6/6	6/18	6/6	6/6	-	110/80	195	136	39	121	30	0.9	110	7.8	-
80	Krishnaveni	36	F	1.5	6/9	6/12	6/9	6/12	-	130/86	186	143	47	96	28	1.0	121	6.1	-
81	Muthulakshmi	68	F	16	6/36	1/60	6/36	1/60	-	130/74	187	147	46	101	28	0.8	106	5.6	-
82	Angammal	60	F	17	6/60	6/9	6/60	6/9	-	150/100	281	154	39	126	38	0.8	171	11.7	+
83	Aynush	53	F	2	6/60	6/60	6/24	6/24	-	130/70	198	124	41	87	32	0.9	139	6	-
84	Murugesan	58	M	12	6/24	6/24	6/24	6/24	+	160/90	215	177	43	135	56	4.2	183	8	+
85	Jayaseeli	55	F	17	4/60	4/60	4/60	4/60	-	160/108	243	261	48	147	30	0.8	219	12.6	+
86	Arokiasamy	58	M	12	6/36	6/36	6/18	6/18	-	130/80	190	156	40	108	29	1.1	183	9	-
87	Kumarappan	67	M	25	6/60	5/60	6/60	5/60	-	170/90	244	238	36	134	49	3.7	156	8.5	+
88	Vengaiyan	72	M	2	6/60	6/60	6/60	6/60	-	110/70	186	132	47	81	28	0.7	131	5.3	-
89	Malaiammal	63	F	6	6/18	6/36	6/18	6/36	-	110/70	201	147	39	122	26	0.8	79	8.1	-
90	Chidambaram	52	M	10	6/12	6/18	6/12	6/18	-	160/100	158	93	47	143	32	1.7	85	9.8	+